



Tennessee Consolidated Retirement System

Legacy Pension Plans and Aggregate Local Government Agent Pension Plans:

Teacher Legacy Pension Plan

Closed State and Higher Education Employee Pension Plan

Aggregate Local Government Agent Pension Plans (Political Subdivisions)

Actuarial Valuation and Report (for cash funding purposes)

June 30, 2018



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Retirement • Benefits • Human Capital • M&A

October 7, 2019

The Honorable David H. Lillard, Jr.
Chairman, Board of Trustees
Tennessee Consolidated Retirement System
502 Deadrick Street
Nashville, Tennessee 37243-0201

Dear Mr. Lillard:

Submitted herewith are the results of an actuarial valuation of the Tennessee Consolidated Retirement System prepared as of June 30, 2018, pursuant to the provisions of TCA Section 8-34-506. Also included are the actuary's recommendations with respect to contributions by the employers.

We trust that this report will be helpful in formulation of policy with respect to the operation and financing of the System. We very much appreciate the opportunity to serve the Board of Trustees, and will be pleased to supplement this report in any way, as you request.

The staff of the Tennessee Consolidated Retirement System has been extremely helpful and cooperative in developing the information required for this valuation. Their cooperation has been greatly appreciated, and is hereby acknowledged.

Respectfully submitted,



Justin C. Thacker, F.S.A.

Enclosures

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A. INTRODUCTION

An actuarial valuation of the Tennessee Consolidated Retirement System was performed as of June 30, 2018. The purpose of the valuation was to determine the funding requirements of the various components of the System, with the intention that the funding requirements indicated by the valuation would be used as the basis for contributions commencing on July 1, 2019.

The Tennessee Consolidated Retirement System (TCRS) was established as of July 1, 1972 as a successor to the following superseded retirement systems:

- Tennessee State Retirement System
- Tennessee Teachers' Retirement System
- Tennessee Judges Retirement System
- Retirement System for County Paid Judges of Tennessee
- Attorneys General Retirement System of Tennessee
- Public Service Commissioners' Retirement System
- Tennessee Retirement System for County Officials

As of the date of establishment, all members and beneficiaries of the superseded systems were covered under the Consolidated System. The assets of each superseded system were transferred to the credit of the Consolidated System, and no further contributions have been made to the superseded systems by either the members or the employers. Separate accounting is maintained under the Consolidated System for the assets and liabilities attributable to the various classes of members and beneficiaries. Benefits under the System are funded by contributions made by members and employers (including the State). The level of such contributions is determined annually by an actuarial valuation (determined biennially prior to 2015). This report presents the results of the actuarial valuation of the System performed as of June 30, 2018.

The following sections of this report discuss the membership in the System as of the valuation date; the funding levels generated under the approach to funding adopted by the Board; the current financial status of the System as a whole and of each major subdivision of the System; an analysis of the factors causing change in the required contribution levels; the validity of the records on which the study was based; the benefits provided by current and superseded systems; and the data on which the valuation was based and the actuarial assumptions utilized in the valuation.

B. MEMBERSHIP

The statute which established the Tennessee Consolidated Retirement System in 1972 specified the three following classifications of employment:

- Group I Teachers and General Employees (State and Political Subdivisions)
- Group II State Policemen, Wildlife Officers, Firemen and Policemen
- Group III State Judges, County Judges, Attorneys General, County Officials, and Public Service Commissioners

Any person who was a member of a superseded system as of June 30, 1972 became a member of the Consolidated System on the date of establishment. Such a member could elect to remain covered by the benefit and contribution provisions of the superseded system of which he was a member, in which case he was classified as a "prior class member". If he did not so elect, he was classified as a member of Group I, Group II or Group III on the basis of his employment category.

Effective July 1, 1976, all new entrants to the System, without regard to their employment category, entered the System as Group I employees. Despite this change, several small groups (those previously classified as "Group III") are treated differently from the bulk of the general employees with respect to funding levels for various reasons.

Effective September 1, 1990, a new Group IV category became available to State Judges. State Judges previously participating in Group I or Group III became eligible to transfer to the new category, and those becoming State Judges on or after the effective date automatically enter Group IV.

The following tables show the number of active and retired members included in the June 30, 2017 and June 30, 2018 valuations.

THE NUMBER AND ANNUAL COMPENSATION OF
ACTIVE MEMBERS

GROUP	Number		Pct Change	Compensation		Pct Change
	2017	2018		2017	2018	
Group I						
Contributory Teachers	62,320	59,487	(4.5%)	3,414,741,059	3,460,664,012	1.3%
General Employees:						
State	43,080	39,867	(7.5%)	2,152,083,926	2,123,748,748	(1.3%)
University of Tennessee (TIAA)	53	42	(20.8%)	7,091,712	5,759,702	(18.8%)
Separately Funded Systems	574	550	(4.2%)	52,730,434	53,515,377	1.5%
Sub-Total	43,707	40,459	(7.4%)	2,211,906,072	2,183,023,827	(1.3%)
Political Subdivisions	79,819	80,429	0.8%	2,741,394,464	2,832,351,234	3.3%
Total - Group I	185,846	180,375	(2.9%)	8,368,041,595	8,476,039,073	1.3%
Group II						
State Policemen and Wildlife Officers	0	0	--	0	0	--
Firemen and Policemen	5	4	(20.0%)	443,386	369,255	(16.7%)
Total - Group II	5	4	(20.0%)	443,386	369,255	(16.7%)
Group III (including Superseded Systems)						
State Judges - Group III	0	0	--	0	0	--
Attorneys General - Group III	1	0	(100.0%)	161,476	0	(100.0%)
County Judges - Group III	0	0	--	0	0	--
County Officials - Group III	2	2	--	204,178	212,058	3.9%
State Judges - Superseded	0	0	--	0	0	--
Attorneys General - Superseded	1	1	--	151,476	156,024	3.0%
County Judges - Superseded	0	0	--	0	0	--
County Officials - Superseded	2	2	--	134,442	141,364	5.1%
Total - Group III	6	5	(16.7%)	651,572	509,446	(21.8%)
Group IV - Judges	154	147	(4.5%)	26,471,931	25,602,861	(3.3%)
State - All Groups	106,187	100,098	(5.7%)	5,653,770,634	5,669,800,146	0.3%
Political Subdivisions- All Groups	79,824	80,433	0.8%	2,741,837,850	2,832,720,489	3.3%
Grand Total - All Groups	186,011	180,531	(2.9%)	8,395,608,484	8,502,520,635	1.3%

THE NUMBER AND ANNUAL RETIREMENT ALLOWANCES CURRENTLY PAYABLE TO
BENEFICIARIES ON THE RETIREMENT ROLLS

GROUP	Number		Pct Change	Amount		Pct Change
	2017	2018		2017	2018	
Group I						
Contributory Teachers	50,230	50,922	1.4%	1,187,624,014	1,227,138,816	3.3%
General Employees:						
State	53,177	54,670	2.8%	812,320,001	852,879,726	5.0%
University of Tennessee (TIAA)	1,557	1,493	(4.1%)	31,488,428	31,721,207	0.7%
Separately Funded Systems	382	417	9.2%	8,270,865	9,041,316	9.3%
Sub-Total	55,116	56,580	2.7%	852,079,294	893,642,249	4.9%
Political Subdivisions	46,621	48,363	3.7%	376,190,301	402,010,661	6.9%
Total - Group I	151,967	155,865	2.6%	2,415,893,609	2,522,791,726	4.4%
Group II						
State Policemen and Wildlife Officers	486	468	(3.7%)	17,571,442	17,430,992	(0.8%)
Firemen and Policemen	494	485	(1.8%)	14,637,893	14,718,414	0.6%
Total - Group II	980	953	(2.8%)	32,209,335	32,149,406	(0.2%)
Group III (including Superseded Systems)						
State Judges - Group III	1	1	--	86,459	88,275	2.1%
Attorneys General - Group III	15	16	6.7%	772,947	881,479	14.0%
County Judges - Group III	23	21	(8.7%)	600,322	576,833	(3.9%)
County Officials - Group III	55	52	(5.5%)	1,332,789	1,279,568	(4.0%)
State Judges - Superseded	39	40	2.6%	3,433,909	3,433,234	(0.0%)
Attorneys General - Superseded	94	91	(3.2%)	5,703,743	5,325,770	(6.6%)
County Judges - Superseded	58	50	(13.8%)	2,841,516	2,411,130	(15.1%)
County Officials - Superseded	87	79	(9.2%)	2,273,666	2,098,440	(7.7%)
Total - Group III	372	350	(5.9%)	17,045,351	16,094,729	(5.6%)
Group IV - Judges	186	195	4.8%	8,605,281	9,290,082	8.0%
State - All Groups	106,390	108,515	2.0%	2,082,925,382	2,163,596,868	3.9%
Political Subdivisions- All Groups	47,115	48,848	3.7%	390,828,194	416,729,075	6.6%
Grand Total - All Groups	153,505	157,363	2.5%	2,473,753,576	2,580,325,943	4.3%

C. DETERMINATION OF FUNDING LEVELS

General Method

The statute which established the Tennessee Consolidated Retirement System prescribed a "frozen initial liability" method of valuation, under which an initial unfunded accrued liability is established for each major cost group, and the remainder of the cost of the System is borne by a "normal cost" contribution. Under that method as it is usually utilized, the "normal cost" calculated as a part of each subsequent valuation absorbs any variation of actual from expected experience.

Prior to 1975, the unfunded accrued liability was not being amortized. In that year, a 40-year amortization of the unfunded accrued liability was begun, except that (in accordance with the statute at that time) cost of living benefits remained on a "pay-as-you-go" basis.

In 1977, the statute was changed to provide for advance funding of cost of living benefits. It was decided to amortize the additional accrued liability arising from these benefits as a percent of payroll, rather than by level dollar annual payments. The result was to arrive at a contribution rate consisting of three segments: a "normal cost"; an "accrued liability level dollar" amortization of the unfunded accrued liability for basic benefits; and an "accrued liability percent of payroll" amortization for the additional accrued liability arising from cost of living benefits. For closed groups, all of the unfunded accrued liability was amortized on a level dollar basis.

Prior to the 2015 valuation, the Trustees decided whether to freeze the prior valuation's unfunded accrued liability, or to reestablish that figure. From time to time, the unfunded accrued liability was reestablished rather than frozen. Reestablishment generally occurred when there were significant changes in benefits or actuarial experience and was elected in order to more accurately portray the unfunded liability of the system.

In 2014, the TCRS Board of Trustees adopted a funding policy applicable to all employers. The funding policy requires actuarial valuations to be performed annually beginning as of June 30, 2015, utilizing the entry-age normal actuarial funding method. In addition, the funding policy requires unfunded liabilities to be amortized utilizing the level dollar amortization method over a closed period not to exceed 20 years. A tier approach is required for new actuarial gains and losses created from each actuarial valuation. The amortization period of each tier may be shortened or extended from valuation to valuation to manage volatility but the specific tier must be completely amortized within 20 years of its original creation.

Funding History

In 1981, the State began making the contributions previously made by State Group I employees and teachers associated with higher education, in lieu of part of the salary increase these participants would otherwise have received. Separate contribution rates were developed for "contributory" (K-12) teachers and "non-contributory" (higher education) teachers. These rates were artificially adjusted so as to retain a reasonable relationship between the two rates; exact separate calculations were not made because the total pool of assets accumulated for teachers was not being accumulated separately for the two groups.

In 1983, several improvements were made to the funding program:

1. The unfunded accrued liability was treated as if it had been frozen in 1981, rather than being reestablished. This action had little effect on 1983 contribution rates, but established the desired precedent — once frozen, the unfunded accrued liability would decrease regularly until it disappeared in 2015.
2. All of the "percent of payroll" amortization piece for State employees and 70% of the equivalent piece for teachers were shifted to the stronger "level dollar" amortization basis.
3. Contribution rates for several of the smaller groups were recombined to reflect more accurately the sources of the money used to fund them.

Separate rates were again computed for "contributory" and "non-contributory" teachers, involving an artificial differential intended to keep the relationship of the two rates reasonable.

In 1984 and again in 1985, the Legislature allocated excess general State funds to the TCRS. Some of these funds were allocated to the superseded ("prior class") State Judges and Attorney General Systems, for which existing funding was not proving adequate. The intention of this infusion of funds was to make it feasible to fund the remaining liabilities of these closed systems in reasonably level dollar amounts over the next 30 years. Other funds were intended to fund in advance the "bonus", "aged teacher" and "aged State employee" programs that had previously been funded on a year-by-year basis from the operating budget.

In 1985, the remaining 30% of the frozen accrued liability for teachers was shifted to the "level dollar" amortization basis. A new set of actuarial assumptions was adopted, based on the 1984 study of actual experience under the TCRS. The rates called for by the 1985 valuation were generally somewhat lower than the rates then being contributed. As a conservative measure, the Board of Trustees voted to continue utilizing the then-current rates, rather than allowing the rates to drop.

Between 1985 and 1987, the TCRS experienced large actuarial gains due to investment earnings substantially in excess of the actuarial assumption of 8.5%. Even when the smoothing procedure utilized since 1981 was applied to plan assets, to avoid undue fluctuations in contribution rates, the strong investment performance of the two-year period generated actuarial gains, lowering the required contribution rates. The Board of Trustees, unsure how the stock market would react to a 500 point decline of the Dow Jones Industrial Average on October 19, 1987, adopted contribution rates which "split the difference" between the then-current rates and the much lower rates called for by the 1987 valuation. Contribution rates for the major groups still dropped significantly; nevertheless, the adopted rates included considerable margins over the "required" rates, in order to minimize the likelihood of having to increase the rates in 1989.

Also in 1987, a "consolidated State" contribution rate covering all groups for whom the State was directly responsible was adopted. This group included higher education (non-contributory) teachers and a closed group of University of Tennessee teachers whose TIAA benefits are supplemented by the TCRS, as well as all Group I and Group II State employees. This change was made for purposes of administrative simplicity, and also to avoid questions concerning classification of higher education employees which had arisen in the past. Teachers who were still contributing to the TCRS (K-12 teachers) remained as a separate group.

Between 1987 and 1989, the valuation "target" rates necessary to continue the 40-year funding program begun in 1975 decreased still further. Several factors contributed to this decline. First, the unfunded accrued liability frozen in 1981 was being amortized by level dollar annual contributions; as the covered payroll increases, as it had each year since 1983, these level dollar amounts represent a decreasing percentage of each year's covered payroll. Second, actuarial gains had emerged. Third, the fact that contributions during the two years actually exceeded the targets called for by the 1987 valuation meant that current assets exceeded

the amounts which would have been on hand if the valuation "target" rates had actually been adopted. For all these reasons, the 1989 valuation rates declined significantly from the 1987 rates.

A 1988 study of experience under the TCRS had led to the adoption by the Board of Trustees of a new set of actuarial assumptions for the 1989 valuation. While some of the new assumptions would require less money to go into the trust (for example, it was assumed that continuing participants would receive annual salary increases of 7% each year, rather than 8%), overall the new set of assumptions was more conservative than the old set. Therefore, the "1989 valuation rates" were somewhat higher than they would have been if the new, more conservative set of assumptions had not been adopted.

Because it was felt that most of the conditions which had caused the required contribution rates to decline from 1987 to 1989 would continue to apply after 1989, the Board of Trustees voted to adopt the 1989 "target" rates as the actual contribution rates, effective July 1, 1990.

As expected, the required contribution rates developed in 1991 were lower than the 1989 rates. The Board of Trustees again voted to adopt the 1991 "target" rates as the actual contribution rates, effective July 1, 1992.

The quadrennial experience study performed in 1992 indicated that the demographic assumptions which had been used in the 1989 and 1991 valuations had turned out to be accurate. Investment performance during the preceding few years had substantially exceeded the 8% interest assumption, and salary increases during the last few years had fallen short of the 7% salary assumption. Therefore, the Board of Trustees took the position that continuing to utilize the same set of actuarial assumptions was an appropriate practice, retaining a reasonable yet conservative approach to the calculation of required contribution rates.

From 1991 to 1993, the System generated unusually large actuarial gains. Investment earnings exceeded expected earnings (on the 8% basis) by over \$675,000,000. Freezes on salaries had minimized salary increases during the valuation period, leading to additional large actuarial gains. The effect of these two large sources of gains was to lower required contribution rates substantially.

A further result of these actuarial gains was to create several anomalies in the funding method; the most prominent of which was a "negative normal cost" for the Consolidated State. The unfunded accrued liability of each group for which a contribution rate is obtained had not been reestablished since 1981. During that period, there had been substantial actuarial gains, culminating in the large gains from 1991 to 1993. All of the gains had been absorbed into the "normal cost" component of the contribution. As a result, the remaining unfunded accrued liability had become the major component of the remaining employer liability; in the case of the Consolidated State, the unfunded accrued liability, which had been brought forward as a dollar amount from year to year, exceeded the State's total liability for the group.

In order to remove these anomalies, the Board of Trustees decided, as authorized by TCA Section 8-37-304, to reestablish the unfunded accrued liability for each group. The result was that a much smaller unfunded accrued liability remained for teachers, that unfunded accrued liabilities increased for County Judges and Officials and for State Judges and Attorneys General (Superseded), and that there was no longer an unfunded accrued liability for the other contribution groups.

Actual contributions for the two smaller groups which still had unfunded accrued liabilities were not affected by the reestablishment. Benefits for County Judges and Officials are funded through litigation taxes, so the actuarially determined contribution rate serves only as a benchmark. Superseded State Judges and Attorneys General were being funded by level annual contributions which were intended to pay off the group's total liability by 2015, without regard to the subdivision between "normal cost" and "accrued liability."

Rather than allowing the rates to drop substantially, the Board of Trustees followed the course which had been authorized in previously-approved legislation:

1. Portability among members who had service in more than one membership classification was improved.
2. The base benefit of active and retired members in most categories was increased by 5%.
3. The amortization period for the Contributory Teachers was decreased to 10 years. However, the Board retained the right to increase the amortization period in the future.

Even after these benefit and funding improvements, the 1993 contribution rates for the major groups decreased slightly.

From 1993 to 1995, actuarial experience was not as favorable as it had been in prior years. Although the required contribution rate for Contributory Teachers decreased further, the required contribution rate for the Consolidated State group increased for the first time in several years.

The Trustees adopted the actuary's recommendation that unfunded accrued liabilities be reestablished for the three groups for which such liabilities existed. Since Section 8-37-305 of the TCA specifies that the accrued liability contribution is to be discontinued for any member classification as soon as the unfunded accrued liability becomes zero, the unfunded accrued liabilities were not reestablished for the groups which had reached that goal in 1993. Reestablishment for the three entities with remaining liabilities was elected in order to maintain a more realistic balance between the accrued liability contribution and the normal cost contribution.

As mentioned above, the Board retained the right to extend the amortization period for Contributory Teachers from the eight-year period remaining from the ten-year amortization schedule adopted in 1993 to a period that in 1995 was permitted to be as much as twenty years. The primary purpose of retaining this right was as a safety valve to avoid undue strain on the State's resources in the event of a future increase in required contributions due to actuarial losses. Reversion to the twenty-year amortization schedule was elected in order to mitigate contribution volatility associated with the leveraged position as plan assets equaled approximately 80% of projected benefit values.

The quadrennial experience study conducted in 1996 led the Trustees to adopt a set of more conservative withdrawal and mortality assumptions for the Contributory Teacher group. The study also concluded that economic assumptions should be revised to reflect lower prevailing rates of inflation, as inflation had declined significantly since the previous review was conducted. Consequently, the assumed investment return rate was revised downward from the 8% per annum rate used in the 1995 valuation to 7.5%. The assumed annual rate of salary increase, which is also expected to contain an inflation component, was revised downward from 7% to 5.5%.

Unrelated to the assumption changes resulting from the experience study was a recommended modification in the asset valuation method. An asset smoothing procedure had been applied in determining the asset value upon which contributions are based since 1981. The purpose of the smoothing process was to dampen the effect of investment volatility so that contributions were not unduly affected by short-term changes in investment results. Under the procedure used in prior plan valuations, fixed income investments had been treated differently than equities and had been valued at book value. Equities were valued by adjusting the book value of the equity portion of the portfolio by a factor which reflected the five-year moving average ratio of the equity market to book values.

While the previous methodology had served the purpose of reducing volatility adequately, the procedure differed from the methods mandated by the then recently applicable Governmental Accounting Standards Board (GASB) Statements 25 and 27. Under the GASB standards, the entire portfolio, rather than the equity

portion only, must be adjusted to recognize changes in market value. The revised methodology approved for the plan expanded the moving average procedure then in use to apply to all plan assets.

The 1997 valuation recognized benefit modifications that were adopted by the legislature in the 1997 Appropriation Act as follows –

1. The arithmetic, or simple, form of cost-of-living adjustment was replaced by a geometric, or compounded, adjustment. The modification was effective January 1, 1998 and included a "catch-up" feature for then current retirees.
2. Salary "loading" for Consolidated State employees hired prior to July 1, 1981 and for whom employee contributions had been eliminated was permanently extended.
3. Contribution rates related to the geometric cost-of-living adjustment and permanent salary extension were implemented effective as of January 1, 1998 and July 1, 1998, respectively.

As of July 1, 1997, an unfunded accrued liability remained for the Contributory Teacher group and two other small groups. The Trustees elected to reestablish the liability for all three groups resulting in the elimination of the unfunded accrued liability for Contributory Teachers and leaving an unfunded accrued liability for only the County Judges and Officials and State Judges and Attorneys General (Superseded).

Contribution rates produced by the 1999 valuation continued to benefit from favorable investment experience. Lower than expected salary increases to Teachers also contributed to lower contribution rates. Factors influencing higher contributions were the addition of new entrants for whom contribution rates were higher because they did not benefit from prior accumulated gains and modifications in valuation programming to accommodate improvements in valuation techniques. The trend for the Teachers employer contribution rate continued to decline. An increase in the State employer contribution rate resulted in the State rate for the first time exceeding that for Teachers.

Between 1997 and 1999, TCRS record keeping procedures were revised to eliminate maintenance of the fund book value. Since prior asset valuation methods were based on a historical comparison of the relationship between book and market value, the valuation asset method was revised for the 1999 valuation. A primary consideration in selecting the revised method was that the prior method should not be altered more than necessary. Under the revised method, the asset value used in computing plan contributions was determined by recognizing "excess earnings" occurring in each preceding year over a five year period following the year of recognition. Excess earnings in a year are earnings above the investment returns that would have occurred if the plan earned the actuarially assumed rate for the year. Excess earnings or losses so computed for each year were phased in ratably over five years. For conservatism, excess gains or losses for a year were applied first to offset accumulated excess earnings on a dollar for dollar basis before phasing in the remainder.

During 1999, an actuarial audit of the primary calculations underlying the valuation was conducted by Buck Consultants. Conclusions and opinions resulting from the audit were discussed in a report prepared by Buck Consultants. Significantly, the audit endorsed the actuarial valuation methodology and the basic liability results used in computing contributions for the TCRS.

A quadrennial experience study conducted in 2000 concluded that economic assumptions including the assumed rate of investment return and the inflation assumption should be unchanged. Modifications were recommended for the salary increase rate and many of the demographic assumptions.

The assumed rate of salary increase employed in the 1999 actuarial valuation was a uniform rate of 5.5% that was applied to all ages. The assumed rate was higher than actual aggregate experience. Also, the pattern of actual salary increase rates was such that increases for younger participants were considerably higher than

those for older participants. An age graded scale was recommended to replace the uniform scale. The revised scale was slightly lower than the prior scale but more accurately reflected career salary patterns.

In the four-year period covered by the experience study, post retirement mortality rates improved extending the precedent established in earlier studies. Improvement was observed for both Teacher and State groups. Since the standard tables did not appear to represent the TCRS retiree mortality pattern, a revised table modeled after TCRS experience was developed.

Predicted rates of termination and retirement of both State and Teacher groups were modified significantly to recognize separation patterns measured on the basis of liabilities. The revised tables recommended by the study resulted in increased contribution rates for both groups. Following a policy of gradual absorption of significant contribution rate changes, the Board elected to phase-in the termination rates for the State and Political Subdivision groups ratably over a cycle of three actuarial biennial valuations beginning in 2001.

The aggregate effect of recommended salary and demographic changes (including the decision to phase-in State termination rates) in the 2001 actuarial valuation was to increase Teacher and State employer contribution rates by 0.3% and 1.1% respectively.

Administrative factors for survivorship, early reduction and delayed retirement had been last revised prior to 1990. Since the time of their adoption, the assumed actuarial valuation interest rate was reduced from 8.0% to 7.5%, and mortality improvements had been implemented. Accordingly, the Board recommended modification of the administrative factors as of July 1, 2002.

Plan contributions established by the 2003 actuarial valuation suffered from continued adverse investment experience. Rates of investment return for fiscal years ending in both 2002 and 2003 were below that assumed in the valuation. Contribution rates for the Teacher and State groups increased by 2.1% and 2.8%, respectively, due primarily to the unfavorable investment performance.

In addition, the 2003 valuation recognized the second step in the phase-in process of adopting the recommended termination rates for the State and Political Subdivision groups. Consolidated State contributions increased by 0.40% due to the 2003 change in termination assumptions.

A quadrennial experience study was conducted in 2004 covering the period of plan operations from July 1, 2000 through June 30, 2004. The review concluded that economic assumptions including the assumed rate of investment return and the inflation assumption should be unchanged. The study also validated the salary increase rates developed with the previous experience study. Modifications, however, were recommended for many of the demographic assumptions.

In the four-year period covered by the experience study, post retirement mortality rates were noted to have improved predominantly in the male population of both the State and Teacher groups, extending the precedent established in earlier studies. As a result, new post retirement mortality rates were recommended to better reflect the actual experience.

Modifications were also recommended with the 2004 experience study to the termination and retirement rates. The new study validated the need to recognize the final phase-in of termination rates for the State group recommended from the 2000 study, with only a minor additional change recommended in 2004. Retirement rates dropped sharply during the study period from 2000 – 2004. Since retirement rate experience could be temporarily related to recent economic cycles, the 2004 study recommended that approximately one half of the reduction in retirement rates be reflected in the actuarial valuation, with further review again during the next experience study.

The 2005 actuarial valuation resulted in continued contribution rate increases for both groups. Contribution rates for Teacher and State groups increased by 2.63% and 3.18%, respectively, due to actuarial experience

primarily from the recognition of prior investment performance. The aggregate effect of the recommended assumption changes in the 2005 actuarial valuation was to reduce the Teacher and State employer contribution rates by 2.0% and 0.14% respectively.

As of July 1, 2005, the unfunded liability was eliminated for the County Judges and Officials group as it became fully funded. An unfunded accrued liability was only recognized for the State Judges and Attorneys General (Superseded) group.

Rates of investment return for fiscal years ending in 2006 and 2007 were 6.9% and 13.2%, respectively. While these market returns exceeded our assumed return for the two-year period, prior losses were still being phased-in with the valuation asset smoothing method for the 2007 valuation. Actuarial experience in the aggregate between 2005 and 2007 resulted in an increase in the contribution level; however, the increase was much smaller than in recent valuations. Contribution rates for Teacher and State groups increased by 0.29% and 0.52%, respectively, due to actuarial experience, primarily the recognition of prior investment performance.

Additional steps were taken with the 2007 valuation in an effort to curb contribution rate volatility going forward. First, the unfunded actuarial accrued liability was reestablished for all groups and amortized over a 20-year period. Even though the unfunded accrued liability had been eliminated in prior years for the State and Teacher groups (mostly due to excess asset performance on the 1990's), adverse investment performance since the 1990's had created an unfunded accrued liability as of the valuation date. The net effect of this change was to reduce the State contribution rate by 0.99%. Since the Teacher group had a relatively small unfunded accrued liability after reestablishment, the change did not impact the Teacher contribution rate.

In addition, a ten-year asset smoothing method was adopted to be used prospectively for fiscal years beginning after June 30, 2007. The purpose of this change was to more adequately smooth investment performance since the plan's contribution rates are so highly leveraged on the volatility of plan assets. It was believed that a ten-year method would more adequately smooth contribution rate volatility than the previous five-year smoothing method. Since this change was prospective only, it did not affect either the unfunded accrued liability or the contribution rates with the 2007 valuation.

The 2007 valuation also recognized benefit modifications that were adopted by the legislature during the prior period as follows –

1. An ad hoc increase for retirees with retirement dates on or before July 1, 1989. This increase was effective prospectively for retired State and Teacher participants on January 1, 2007. Each political subdivision was given the choice of offering the increase to its retirees.
2. Increase in the minimum benefit calculation to General Assembly members. The minimum benefit of \$70 per year of service began being indexed with the same percentage as the COLA paid to retirees effective July 1, 2006.
3. Benefits for public safety officers increased allowing for an unreduced benefit at age 55 with 25 years of service. In addition, the bridge benefit for public safety officers will begin at age 55 instead of age 60. Each political subdivision was given the choice of offering the increase to its public safety officers.

The impact on the State contribution rate due to these benefit improvements was minimal since the number of employees affected were small relative to the entire group.

Since the County Judges and Officials group was deemed to be fully funded as of July 1, 2005, this group was combined with the Consolidated State group for reporting purposes as of July 1, 2007. In addition, the three groups of State Judges and Attorneys General were combined for reporting purposes as of July 1, 2007.

Plan contributions established by the 2009 valuation were again impacted by adverse investment experience. Rates of investment return for fiscal years ending in 2008 and 2009 were negative 1.2% and negative 15.3%, respectively. The market returns between 2007 and 2009 created significant losses for the plan. Actuarial experience in the aggregate resulted in an increase in the contribution level. Contribution rates for Teacher and State groups increased by 4.28% and 5.16%, respectively, due to actuarial experience, primarily the recognition of prior investment performance.

A quadrennial experience study was conducted in 2008 covering the period of plan operations from July 1, 2004 through June 30, 2008. The study compared the actuarial assumptions used to determine contribution rates with the actual experience of the plan. The review concluded that economic assumptions including the assumed rate of investment return and the core inflation assumption should be unchanged. The study also validated the salary increase rates developed in a prior experience study. It was, however, recommended to change the future Cost of Living Adjustment assumption applicable to retiree benefits. The future COLA assumption was changed from 3.0% to 2.5% to better reflect expected experience since the annual COLA is limited to 3.0%. Historical experience validated this change. The effect on employer contributions of adopting the 2.5% future COLA assumption was to decrease the State rate by 2.74% and the Teacher rate by 2.88%.

In the four-year period covered by the experience study, post retirement mortality rates were noted to have improved in both the State and Teacher groups (unlike the 2004 study which reflected little mortality improvement among the Teacher group). As a result, new post retirement mortality rates were recommended to better reflect the actual experience. The effect on employer contributions of adopting the recommended mortality rates was to increase the State rate by 1.61% and increase the Teacher rate by 1.85%.

Modifications were also recommended with the 2008 experience study to the retirement rates. Retirement rates dropped sharply during the study period from 2000 to 2004. The 2004 study reflected only a portion of the change at that time in order to monitor the delayed retirement trend. Retirement rate experience continued to reflect later retirements during the 2004 - 2008 study period. As a result, changes to retirement rates were recommended in order to match experience. As a result of adopting recommended retirement rates, employer contribution rates for the State and Teacher groups decreased by 1.40% and 0.42%, respectively. Other changes to the demographic assumptions were minor and did not result in a significant change in employer contribution rates.

Due to the significant asset losses experienced between the 2007 and 2009 valuations, the valuation assets determined according to the asset smoothing method as of July 1, 2009 were limited to 120% of the market value of assets. In addition, the unfunded actuarial accrued liability was reestablished again for all groups and amortized over a 20-year period. The net effect of the reestablishment was to reduce the State contribution rate by 0.72% and the Teacher contribution rate by 0.30%.

During 2010, an actuarial audit of the primary calculations underlying the valuation was conducted by Gabriel Roeder Smith & Company. Conclusions and opinions resulting from the audit were discussed in a report prepared by Gabriel Roeder Smith & Company. Significantly, the audit endorsed the actuarial valuation results used in computing contributions for the TCRS.

Administrative factors for survivorship, early reduction and delayed retirement had been last revised in 2002. Since the time of their adoption, the assumed actuarial valuation cost of living assumption was reduced from 3.0% to 2.5%, and mortality improvements had been implemented. Accordingly, the Board recommended modification of the administrative factors as of July 1, 2011. No material change to liabilities occurred from this update.

The 2011 actuarial valuation was impacted by strong investment performance during the previous two years. Rates of investment return for fiscal years ending in 2010 and 2011 were 10.2% and 19.6%, respectively. The market returns created significant gains for the plan. Contribution rates in 2011 for Teacher and State groups would have decreased by 3.20% and 3.11%, respectively, due to the actuarial experience and due to the 120% asset corridor that applied in 2009. However, prior investment losses were still being smoothed into the valuation assets. Specifically, \$3,020,000,000 of net investment losses were excluded from valuation assets to be recognized over the next five valuation cycles (ten years). In order to maintain contribution rate stability with the understanding that contribution rates would still need to increase in the future, the amortization periods were lowered to prevent a sharp decline in the contribution rates (6 years for Teachers and 9 years for the State). The net effect of the actuarial experience and resetting the amortization periods was to reduce the Teacher contribution rate by only 0.17% and increase the State contribution rate by only 0.13%.

The 2011 valuation recognized a benefit modification that was adopted by the legislature during the prior period. Political subdivisions may voluntarily elect to establish minimum benefits of \$8, \$14 (indexed), or \$20 (indexed) per year of service for county commissioners, school board members, and other such positions. The effect of this benefit improvement was minimal.

A quadrennial experience study was conducted in 2012 covering the period of plan operations from July 1, 2008 through June 30, 2012. The study compared the actuarial assumptions used to determine contribution rates with the actual experience of the plan. The review concluded that economic assumptions including the assumed rate of investment return, the core inflation assumption and the COLA assumption should be unchanged. The study concluded that salary increase rates should be modified based on recent experience. Salary increase rates were not changed to exactly match the experience observed during the study period, but were reduced by 0.50% at each age to better reflect future expectations. The effect on employer contributions in the 2013 valuation of adopting the lower salary increase assumption was to decrease the Teacher rate by 1.41% of payroll and to decrease the State rate by 1.14% of payroll.

In the four-year period covered by the experience study, post retirement mortality rates were noted to have improved in both the State and Teacher groups (consistent with results observed in the 2008 study). As a result, new post retirement mortality rates were recommended to better reflect the actual experience. The new post retirement mortality rates included a 2-year mortality projection to reflect continued mortality improvements. It was determined that mortality improvements would continue to be monitored in future experience studies with longer projection periods to be considered when appropriate. Pre-retirement mortality rates were modified to be based on the standard IRS tables as provided for by the Pension Protection Act of 2008 (which includes a 15-year projection of future mortality improvements). Disabled mortality rates were also modified to more closely match actual experience. The effect on employer contributions in the 2013 valuation of adopting the recommended mortality rates was to increase the Teacher rate by 1.73% of payroll and increase the State rate by 1.34% of payroll.

Modifications were not recommended with the 2012 experience study to the withdrawal, retirement and disability rates. Since the 2008-2012 study period reflected a difficult economic cycle, it was determined that the demographic experience observed during the period would not appropriately reflect long-term expectations.

The 2013 actuarial valuation saw investment performance during the prior period that was consistent with assumed returns for the plan but contribution rates continued to be impacted by the deferred investments losses from 2008 and 2009. Rates of investment return for fiscal years ending in 2012 and 2013 were 5.6% and 9.9%, respectively. Actual salary increases since the 2011 valuation were less than assumed in the actuarial valuation providing gains, but higher turnover during the period resulted in lower total payroll. Since contribution rates are expressed as a percent of pay, the lower payroll base created upward pressure on the contribution rates. Contribution rates for Teacher and State groups would have increased by 2.17% and 3.05%, respectively, due to the actuarial experience. However, since amortization periods in 2011 were set

lower than normal to maintain contribution rate stability, the amortization periods were reset again in 2013 to continue to manage volatility in the contribution rates. The amortization period was reset to 8 years for Teachers and 13 years for the State. The net effect of the actuarial experience, assumption changes from the 2012 experience study and resetting the amortization periods was to increase the Teacher contribution rate from 2011 by 0.16% and to cause no change to the State contribution rate between 2011 and 2013. The administrative charge applied to contribution rates was decreased in the 2013 valuation to 0.14% of payroll (the charge was 0.16% in the 2011 valuation).

The 2013 valuation recognized a benefit modification that was adopted by the legislature to remove the "AE-65 provision" for all participants who become members on or after July 1, 2011. This change allows participants to continue to receive credit for service after age 65, but removes the comparison of the benefit to the actuarial equivalent of the age 65 benefit upon the final age at retirement. The effect of this change was negligible on the contribution rates.

TCRS pension reform was adopted during the 2013 legislative session that created a new hybrid pension plan for participants hired on or after July 1, 2014 (including different defined benefit formulas, a defined contribution component, cost control features and a stabilization reserve fund). The new plan had no impact on the 2013 actuarial valuation and did not impact benefits for any participant in the original plan (the Legacy Plan). The Legacy Plan was closed to new entrants effective June 30, 2014 but continued to accrue benefits for future service earned by all employees already participating in the Legacy Plan.

Administrative factors for survivorship, early reduction and delayed retirement were updated as of July 1, 2014 to reflect the mortality assumption adopted by the most recent experience study performed in 2012. No material change to liabilities occurred from this update.

The 2015 actuarial valuation reflected investment performance that exceeded assumed returns for the plan, but the asset smoothing method continued to recognize prior losses putting upward pressure on the contribution rates. Rates of investment return for fiscal years ending in 2014 and 2015 were 16.7% and 3.3%, respectively. Cost of living adjustments for the prior period created actuarial gains since the actual COLA's of 1.5% (2014) and 1.0% (2015) were less than the assumed 2.5% COLA. Total payroll declined since the previous valuation mainly for the following two reasons: 1) actual salary increases since the prior valuation were less than assumed and 2) all new employees after June 30, 2014 enter the new Hybrid Plan.

Effective with the 2015 valuation, the plan began using the entry-age normal funding method pursuant to the funding policy adopted by the TCRS Board of Trustees. Changing to the entry-age normal funding method did not impact the results in 2015 as compared to the prior valuation since the unfunded accrued liability had been reestablished in 2013 using the frozen initial liability method (with the entry-age normal method used to determine the accrued liability). Pursuant to the funding policy, the amortization schedule of each gain/loss tier (2013 and 2015) was adjusted with the 2015 valuation to maintain stability in the contribution rates as compared to the 2013 valuation. Annual contribution rates continued to include an administrative charge assumption of 0.14% of payroll.

As required by the funding policy adopted by the TCRS Board of Trustees, actuarial valuations will be performed annually after June 30, 2015.

The 2016 actuarial valuation reflected investment performance during the prior period that was less than the assumed return for the plan. The rate of investment return for the fiscal year ending in 2016 was 2.8%. The cost of living adjustment for the prior period created an actuarial gain since the actual COLA of 1.0% was less than the assumed 2.5% COLA. Total payroll continued to decline as compared to the previous valuation since all new employees after June 30, 2014 entered the new Hybrid Plan. Amortization schedules for each gain/loss tier were adjusted according to the funding policy. Annual contribution rates included an administrative charge assumption of 0.17% of payroll.

A quadrennial experience study was conducted in 2016 covering the period of plan operations from July 1, 2012 through June 30, 2016. The study compared the actuarial assumptions used to determine contribution rates with the actual experience of the plan. The review concluded that economic assumptions, including the assumed rate of investment return, the core inflation assumption and the COLA assumption, should be changed to reflect lower long-term inflation expectations (most notably, the discount rate was reduced to 7.25% for the 6/30/2017 actuarial valuation). The study concluded that salary increase rates should also be lowered based on recent experience and longer-term inflation expectations.

In the four-year period covered by the experience study, post retirement mortality rates were generally observed to have not improved as compared to the 2012 experience study results. Based on the results of the 2016 experience study, TCRS specific mortality tables were created by using a percentage of the RP-2014 White Collar Table (Healthy Annuitants) for Teachers and a percentage of the RP-2014 Blue Collar Table (Healthy Annuitants) for other groups. In order to balance the general expectation that mortality rates may continue to improve with the recent plan experience, post retirement mortality rates will be updated with each actuarial valuation to reflect mortality improvements projected to 6 years beyond each actuarial valuation date (using scale MP-2016 or updates to this scale as available at each actuarial valuation date). It was determined that mortality improvements would continue to be monitored in future experience studies with other projection periods to be considered as appropriate. Pre-retirement mortality rates were modified to be based on the RP-2014 Table for Non-annuitants (with a 15-year projection of future mortality improvements beyond each actuarial valuation date). Disabled mortality rates were not modified from the previous study. Modifications were not recommended with the 2016 experience study to the withdrawal, retirement and disability rates but will continue to be monitored in future experience studies.

The 2017 actuarial valuation reflected investment performance during the prior period that was greater than the assumed return for the plan. The rate of investment return for the fiscal year ending in 2017 was 11.4%, which exceeded the assumed return for the plan. However, due to the operation of the plan's asset smoothing method, the plan reflected an overall asset loss for the period ending 6/30/2017. Assumption change recommendations from the 2016 experience study were reflected and amortization schedules for each gain/loss tier were adjusted according to the funding policy. Annual contribution rates included an administrative charge assumption of 0.19% of payroll.

2018 Valuation

Plan contribution rates resulting from the current and preceding valuations are shown in the schedule on page C-15. The rate of investment return for the fiscal year ending in 2018 was 8.2%, which exceeded the assumed return for the plan (the rate of return on valuation assets during the period was 7.2% which was very close but slightly under the assumed return of 7.25% per annum).

The funding policy requires unfunded liabilities to be amortized utilizing the level dollar amortization method over a closed period not to exceed 20 years. A tier approach is required for new actuarial gains and losses created from each actuarial valuation. The amortization period of each tier may be shortened or extended from valuation to valuation to manage volatility but the specific tier must be completely amortized within 20 years of its original creation. Pursuant to the funding policy, the amortization schedule of each gain/loss tier was adjusted with the 2018 valuation. Amortization periods are shown on pages H-24 and H-25. Annual contribution rates include an administrative charge assumption of 0.22% of payroll.

The impact of plan experience is discussed further in the Gain and Loss Analysis section of the report.

As gains and losses accumulate over time, political subdivisions may experience fluctuations in future contribution rates. In order to reduce contribution volatility, it is recommended that sponsors be permitted to

reset the amortization period upon which payments are based to a new schedule in accordance with the funding policy adopted by the TCRS Board of Trustees.

Future expectations

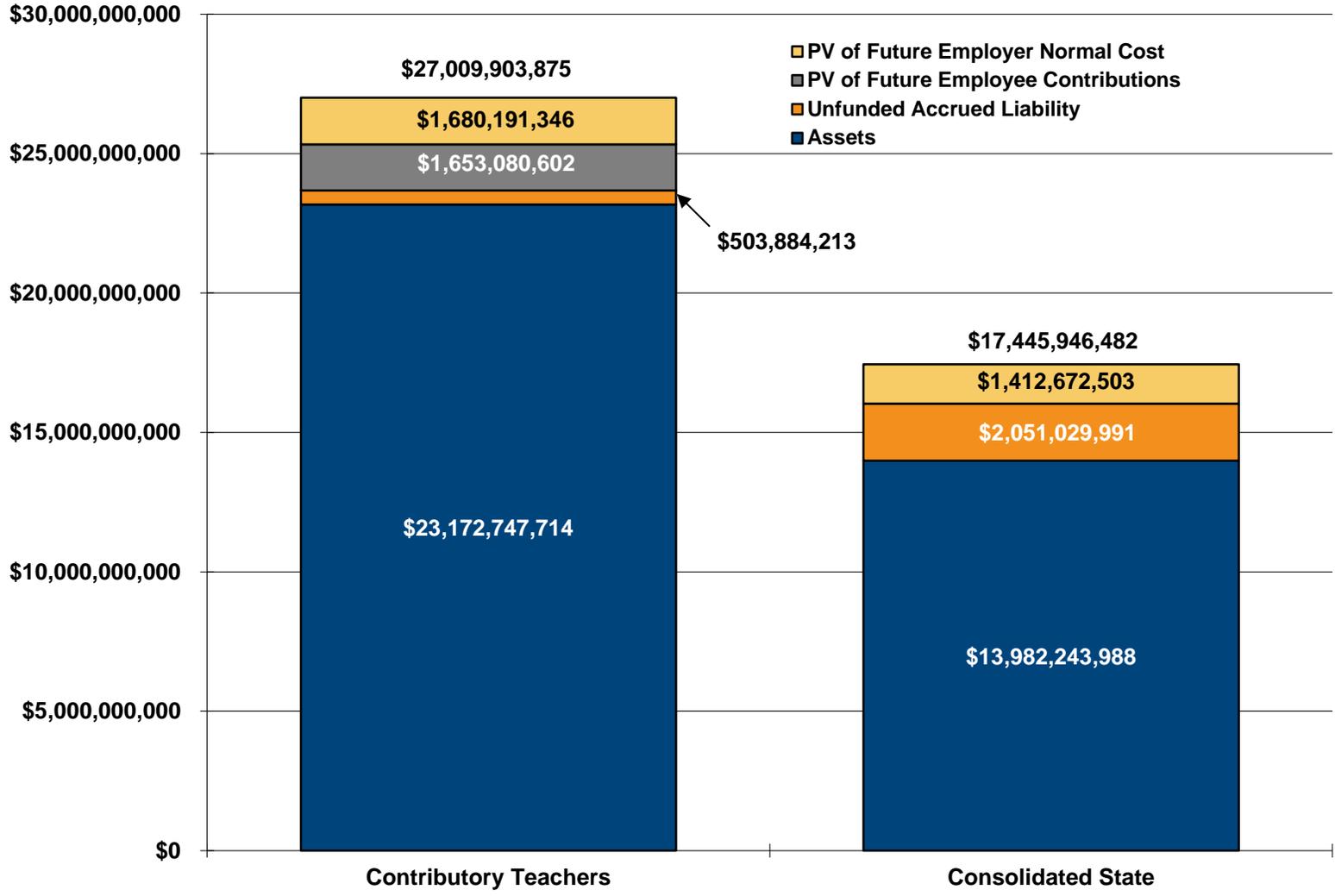
TCRS assets are based upon a valuation asset method that endeavors to reduce contribution volatility by recognizing investment gains and losses ratably over a ten-year period from the date of occurrence. However, investment performance is the most likely source of future contribution rate volatility. Since current TCRS amortization periods are less than those required by the maximums allowable by TCRS funding policy, this volatility can be managed by resetting the amortization period for the unfunded accrued liability in light of long-term contribution rate expectations, budget planning and actuarially sound funding levels.

Additionally, future contribution rate increases will occur if mortality improves more rapidly than projected. The mortality improvement scale is expected to be updated annually with each valuation based on the most recently available information from the Society of Actuaries.

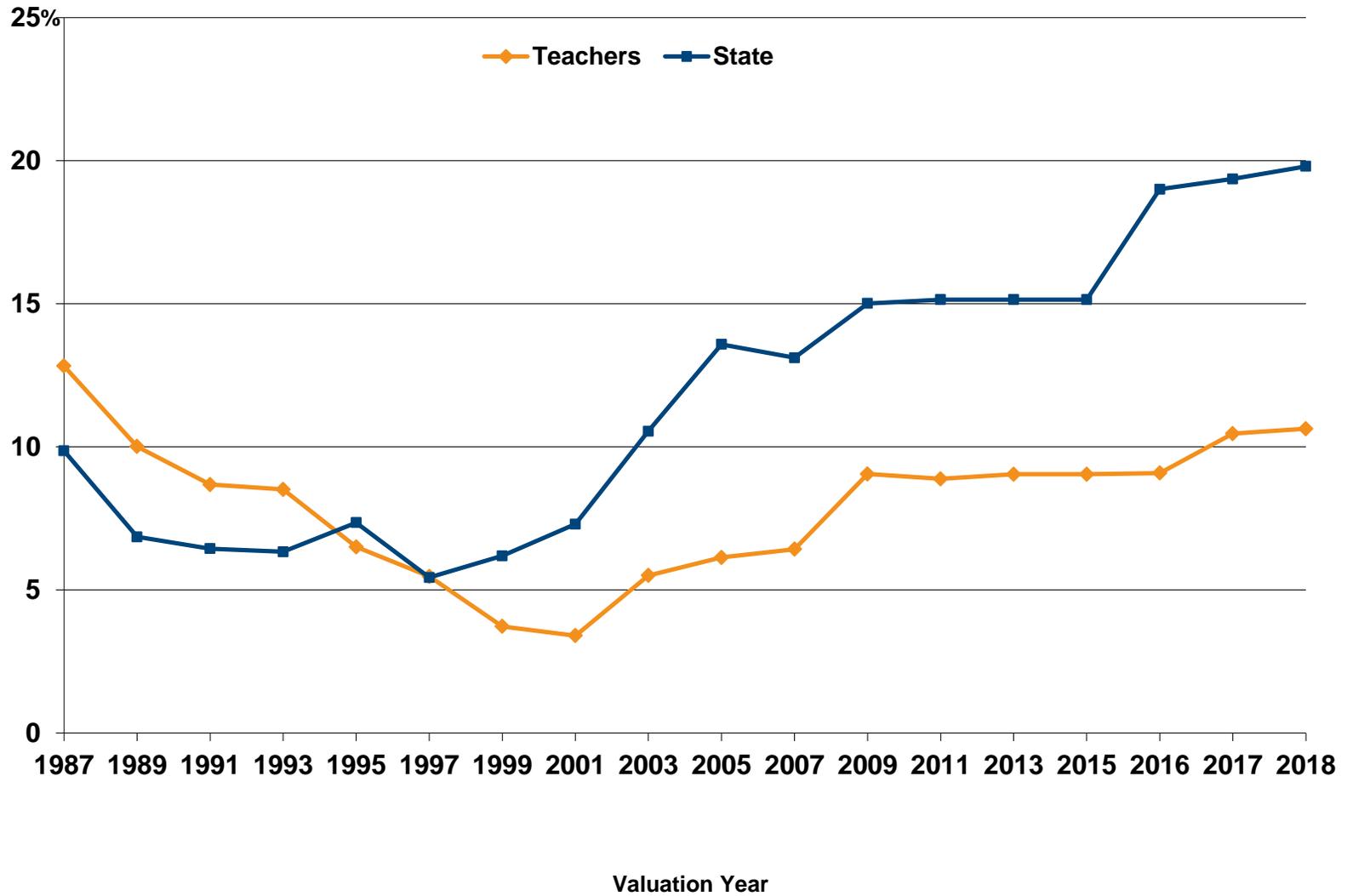
Legacy plan costs and liabilities will gradually change over time since the legacy plan was closed to new entrants effective June 30, 2014. While any large changes should take many years to develop, costs and liabilities will be monitored with each future valuation. It will become necessary to set budget expectations based on the expected dollar contribution requirements of normal cost and amortization of the unfunded liability amounts, rather than a percentage of declining payroll.

VALUE OF BENEFITS

June 30, 2018



HISTORY OF TCRS CONTRIBUTION RATES



COMPARISON OF TCRS EMPLOYER CONTRIBUTION RATES

	2018 Active Payroll	2017 Contribution Rate	2018 Contribution Rate
Contributory Teachers	\$3,460,664,012	10.46%	10.63%
Consolidated State ^{1, 2}	2,130,015,266	19.36%	19.80%
State Judges (Groups I, III & IV), Attorneys General (Groups I & III), State Judges and Attorneys General (Superseded) ³	79,120,868	25.55%	25.55%

- ¹ The Consolidated State contribution rate includes the costs attributable to bridge and service retirement benefits for public safety officers. A separate contribution rate for this group will be collected and will offset the Consolidated State contribution rate.
- ² The University of Tennessee pays an additional 10% of covered payroll for TIAA coverage. The rates shown relate only to TCRS benefits.
- ³ State Judges (Groups I, III & IV), Attorneys General (Groups I & III) and State Judges and Attorneys General (Superseded) are combined for reporting purposes.

VALUATION BALANCE SHEET
 TENNESSEE CONSOLIDATED RETIREMENT SYSTEM
June 30, 2018

ASSETS	Contributory Teachers	Consolidated State (A)	State Judges & Attorneys- General (B)	Total State (A) + (B)
Present assets creditable to:				
State Accumulation Fund	\$19,663,115,437	\$13,711,295,466	\$431,405,061	\$14,142,700,527
Members' Fund	3,509,632,277	270,948,522	26,334,805	297,283,327
Total Present Assets	\$23,172,747,714	\$13,982,243,988	\$457,739,866	\$14,439,983,854
Present value of prospective contributions payable to:				
State Accumulation Fund:				
Normal	\$1,680,191,346	\$1,412,672,503	\$52,042,728	\$1,464,715,231
Accrued Liability	503,884,213	2,051,029,991	97,654,474	2,148,684,465
Total	\$2,184,075,559	\$3,463,702,494	\$149,697,202	\$3,613,399,696
Members' Fund	1,653,080,602	0	1,131,430	1,131,430
Total Prospective Contributions	\$3,837,156,161	\$3,463,702,494	\$150,828,632	\$3,614,531,126
Total Assets	\$27,009,903,875	\$17,445,946,482	\$608,568,498	\$18,054,514,980
LIABILITIES				
Present value of prospective benefits payable on accounts of:				
Present retired members and contingent annuitants				
and contingent annuitants	\$13,754,852,811	\$9,756,312,489	\$293,683,386	\$10,049,995,875
Present active members	12,739,176,328	6,949,748,883	301,959,229	7,251,708,112
Former members	515,874,736	739,885,110	12,925,883	752,810,993
Total Liabilities	\$27,009,903,875	\$17,445,946,482	\$608,568,498	\$18,054,514,980

Political Subdivisions

An actuarial balance sheet showing the assets and liabilities relating to the participating political subdivisions will be added as an appendix to this report when it is available.

D. GAIN AND LOSS ANALYSIS

The contribution rate for any defined benefit pension plan is based on a set of actuarial assumptions. It is assumed that investments will increase in value at a certain rate, that salary increases will be granted according to a certain schedule, and that, in the aggregate, participants will withdraw, become disabled, die, and retire in certain patterns. Assumptions must also be made concerning other events — for example, the pattern of future social security increases, or the percentage of participants who are married at the time of death.

It is possible to predict what would happen to the present value of benefits, the plan's assets, the normal cost rate, and the unfunded accrued ("past service" or "supplemental") liability from one valuation date to the next if all the actuarial assumptions prove to be exactly correct. Variations from these predicted values arise whenever actual experience differs from the actuarial assumptions. Analysis of these variations can reveal the degree to which actual experience has differed from assumed and can, over a period of years, provide an indication as to the validity of the various actuarial assumptions. Variations from "predicted" values also can arise from external sources, such as benefit changes and refinement of programming techniques.

A complete gain and loss analysis is a complex, technical task. It requires that the initial valuation be reproduced, predicting the amount of reserve expected to be released due to each type of decrement (death, disability, retirement, withdrawal) and the amount of liability expected to be incurred as a result of those terminations. Similar "expected" values must be obtained for increases in liability due to salary increases, and for changes in assets due to contributions, benefit payments, and interest earnings.

All these quantities must then be compared to actual experience. This process requires tracing each individual from the first valuation, determining if he is still active or, if not, why not and what benefit was paid and/or what liability remains for him.

Because of the complexity of this task, the primary procedure for analyzing TCRS experience has been the experience study. The most recent experience study covers the period for July 1, 2012 through June 30, 2016 and is set forth in a separate report.

One of the difficulties with a gain and loss analysis is the lack of intermediate check points at which progress can be determined. An initial value is projected, and is compared to an actual value at the end of the period. As a completely separate process, the "gain" or "loss" from each of a number of separate sources is calculated. It is then hoped that the net effect of the various gains and losses will approximately equal the difference between the projected value and the actual value. There is no method by which an individual gain or loss item can be "checked" against an intermediate figure.

Gains and losses may be measured with respect to the present value of benefits, the accrued liability, or the normal cost percentage. The gain and loss analyses with each valuation are conducted with respect to the normal cost percentage in order to measure the impact on the contribution rate.

The availability of a detailed analysis of past actuarial experience through the experience analysis process mitigates the need for a comparable analysis in the valuation. Due to the availability of accurate detailed information in the experience report, the scope of valuation experience analyses was limited to the more accessible sources of gain and loss. Specifically, gains and losses due to death, disability, and turnover were not analyzed, since it was felt that doing so involved time and expense disproportionate to the attention given the results. Similarly, effects of early and delayed retirement were not quantified.

The table below indicates the effect of each measured assumption upon the 2018 valuation contribution rates.

CAUSES OF CHANGE IN CONTRIBUTION RATE

	Teachers	Consolidated State
Investment results	0.06%	0.04%
Salary increases	0.25	0.05
New entrants	0.00	0.00
Cost of living escalation	(0.06)	(0.06)
Prior service purchases/Sick leave	0.10	0.10
Contribution rate change delay	0.13	0.03
Effect of turnover on total payroll	0.03	0.32
Update Mortality Projection	(0.15)	(0.19)
Other	(0.19)	0.15
Subtotal	0.17%	0.44%
Re-amortization of unfunded liability	0.00%	0.00%
Total Change	0.17%	0.44%

Presented below is a brief discussion regarding items in the table. Comparisons to assumptions and methods are made to the assumptions and methods used in the previous valuation conducted in 2017.

Investment results - Market value returns on plan assets during the fiscal year ending June 30, 2018 was 8.19%. Investment performance is not reflected immediately in the valuation asset amount. Valuation assets are based on a ten year moving average of market values. The rate of return on valuation assets during the same period was approximately 7.2% per annum (very close to assumed return of 7.25% per annum).

Salary Increases - The annual weighted-average rate of salary increase during the 2017-2018 period for both the Teacher and State groups were above the assumed age-based rate, which resulted in an increase in the contribution rate.

New Entrants - Rate pressure attributable to new entrants exists when the overall contribution rate is higher or lower than the contribution rate associated with only the new entrants. Contribution rates can be different for new entrants in comparison to rates for continuing participants, who benefit from past accumulated actuarial

gains or losses. Since the Legacy Plan was closed to new entrants effective June 30, 2014, there is no impact on the contribution rates for new entrants.

Cost of Living Escalation - The inflation experienced during the review period produced a COLA increase of 2.1% as of July 1, 2018, which was less than the assumed rate of 2.25% per year. Lower than anticipated COLA adjustments among retirees resulted in a lower liability for these participants than expected.

Prior Service Purchases and Sick Leave Credits - Employee purchases of prior service credits and credits for sick leave result in liabilities to the plan that are not fully offset by related employee contributions. The impact of prior service purchases and sick leave credits has been estimated for purposes of the gain and loss summary.

Contribution Rate Change Delay - The policy of delaying the application of contribution rates produced by a valuation for one year means that contributions in the year following the valuation are greater or less than those actually required by the valuation. Since the contribution rates utilized during the fiscal year ending June 30, 2018 (from the 2016 valuation) were lower than the rates produced from the 2017 valuation, there was an increase in the current contribution rates to make up for the one-year delay.

Effect of turnover on total payroll - Total payroll declined during the review period for the State group as the reduction due to turnover was greater than the growth due to salary increases. Since contribution rates are expressed as a percent of pay, the lower payroll base led to an increase in the contribution rate for both groups.

Update Mortality Projection - The mortality improvement assumption adopted with the 2016 experience study utilizes the most current projection scale published by the Society of Actuaries as of the actuarial valuation date. As of June 30, 2018, the projection scale was updated from Scale MP-2016 to Scale MP-2017. This change resulted in a decrease in the liabilities and contribution rates.

Other - The "other" category in the table above incorporates items that are not separately identified or are relatively insignificant. Included in the "other" category are minor census changes and differences between assumed and actual rates of retirement, termination, death and disability.

E. FUNDING STATUS

The schedule presented herein is based upon valuation results for the current valuation period. Information for earlier periods is presented in the TCRS Comprehensive Annual Financial Report. Results displayed in the following table are based upon the entry-age normal actuarial funding method. Assets shown are the Actuarial Value of Assets. The Market Value of Assets can be found in Section H.

**Tennessee Consolidated Retirement System
Schedule of Funding Progress
June 30, 2018**

Funding Group	Actuarial Value of Assets	Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Covered Payroll	Unfunded Actuarial Accrued Liability as a Pct of Covered Payroll
Consolidated State	\$13,982,243,988	\$16,033,273,979	\$2,051,029,991	87.21%	\$2,130,015,266	96.29%
State Judges & Attorneys General	457,739,866	555,394,340	97,654,474	82.42%	79,120,868	123.42%
Total State	\$14,439,983,854	\$16,588,668,319	\$2,148,684,465	87.05%	\$2,209,136,134	97.26%
Teachers	23,172,747,714	23,676,631,927	503,884,213	97.87%	3,460,664,012	14.56%
Total	\$37,612,731,568	\$40,265,300,246	\$2,652,568,678	93.41%	\$5,669,800,146	46.78%

Political Subdivisions

The schedule of funding progress for the participating political subdivisions will be added as an appendix to this report when it is available.

F. VALIDITY OF DATA

The quality of the records available on retired members and on active members was excellent. Almost every record relating to a retired life was used in the valuation. Similarly, very few records on active participants had to be excluded due to questionable data. A list of the records containing apparent discrepancies has been furnished to the staff of the System.

In addition to retired and active members, the master records of the System contain approximately 45,300 records for former members with deferred vested benefits and approximately 54,500 records on other terminated members. Of this latter group, about 20,600 relate to those who terminated without vested benefits, but who have not withdrawn their contributions, and the remaining 33,900 relate to those for whom records are incomplete for various reasons, such as failure to complete membership cards, reporting contradictory social security numbers, etc.

For inactive members with vested benefits, the vested benefit was calculated and the value of the benefit was compared with the current value of the member's accumulated contributions; the larger of the two amounts was established as a liability of the System. For all other "miscellaneous" categories, the amount of each member's accumulated contributions was established as a liability of the System; thus, some liability was established for each of these records.

		Total State	
		(Including State	
		Judges &	
	Contributory	Attorneys-	Political
	Teachers	General)	Subdivisions
Number of Deferred Vested	9,366	21,005	14,886
Average Age of Deferred Vested	46.2	52.3	51.2
Average Earnings of Deferred Vested	\$42,495	\$31,320	\$26,800
Average Service of Deferred Vested	9.6	9.1	9.5

G. OUTLINE OF BENEFIT AND CONTRIBUTION PROVISIONS

(As Amended through June 30, 2018)

Any person who becomes a teacher not participating in a local retirement fund, a general employee of the State, a state policeman, or a wildlife officer on or after July 1, 1972 becomes a member of the Tennessee Consolidated Retirement System as a condition of employment. Membership is optional for any person who becomes a state judge, a part-time employee, a commissioner, a county judge or county official in a participating political subdivision, an attorney general, an assistant attorney general, a criminal investigator, or an elected or appointed official of the general assembly. Membership is mandatory for any person employed on or after July 1, 1993 as an attorney general in the office of the Attorney General and reporter. Membership is compulsory for other employees of participating political subdivisions, except that for employees in service on the date the political subdivision commences participation, membership is optional.

A member of a superseded system as of June 30, 1972 had the choice of becoming a Group I, II, or III member of the Consolidated System according to his employment classification, or remaining subject to the benefit and contribution provisions of the superseded system as a "prior class" member with all rights, benefits and privileges under the superseded system. This choice was extended to members eligible to enter Group III prior to September 1, 1974. A transferred former Class A or Class B member of the System who is not a prior class member receives the greater of the retirement allowance provided under the Consolidated System or the superseded system. Effective July 1, 1976, all new members began to enter Group I, regardless of employment classification. Effective September 1, 1990, new state judges began to enter a new Group IV; Group I and Group III state judges could elect to transfer to this new category.

"Creditable service" means membership service under the Consolidated System for which contributions are made by the member, plus prior service credited under a superseded system as of June 30, 1972. Additional service may also be credited for certain periods of military service and service before the date of membership for which the member makes the required contributions.

The term "Average Final Compensation "(AFC) means average compensation during the five consecutive years of creditable service producing the highest average. "Social Security Integration Level" (SSIL) means, for the calendar year in which a member retires, the average annual amount of earnings (rounded to the nearest multiple of \$600) with respect to which old age and survivors' benefits would be provided under Title II of the Federal Social Security Act for a male employee attaining age 65 in such calendar year, computed as though for each year prior to such calendar year, annual earnings are at least equal to the maximum amount of earnings subject to contributions under the provisions of the Federal Insurance Contributions Act. The SSIL is \$78,000 in 2018 and will be \$80,400 in 2019. "Social Security Base" (SSB) means for each calendar year the amount of a member's compensation subject to Social Security contributions, except that for years prior to 1966 SSB means \$6,600 for the superseded Teachers' System. For the period prior to July 1, 1963 SSB means \$4,200 and for the period between July 1, 1963 and January 1, 1966 SSB means \$4,800 under the superseded State System. "Benefit Base" (BB) means the annual salary in the position from which certain prior class members in a superseded system covering elected officials retired, as of the dates of their retirement; except that for members who are eligible for escalation, the Benefit Base is increased to reflect any post-retirement changes in annual salary for the position from which the member retired.

The regular form of benefit under the System is a monthly annuity payable to the member for life, with all payments ceasing at his death. In lieu of the regular benefit, a member may elect an optional plan to convert

his allowance into a reduced benefit of equivalent actuarial value in accordance with one of the following options:

Option I - In the event of the member's death, the designated beneficiary will receive 100% of the member's reduced monthly benefit for life.

Option II - In the event of the member's death, the designated beneficiary will receive 50% of the member's reduced monthly benefit for life.

Option III - In the event of the member's death, the designated beneficiary will receive 100% of the member's reduced monthly benefit for life. Should the beneficiary die before the member, the benefit payable to the member reverts to the unreduced regular benefit.

Option IV - In the event of the member's death, the designated beneficiary will receive 50% of the member's reduced monthly benefit for life. Should the beneficiary die before the member, the benefit payable to the member reverts to the unreduced regular benefit.

Social Security Adjustment - A member may convert his retirement allowance into an increased benefit payable prior to the date he is eligible to receive Social Security benefits and a reduced allowance payable after that date, so that his total income will be approximately the same before and after the commencement of Social Security payments.

Benefits payable to retired members are increased on each July 1 according to the percentage increase in the Consumer Price Index during the preceding calendar year, provided that the increase will not exceed 3% of the current benefit in any year, and provided that the member has been retired for at least 12 months. Prior to July 1, 1998, the CPI increase percentage was applied to the initial base, rather than the current benefit.

Every member is guaranteed the return of his account balance arising from his own contributions (including interest) either as benefit payments to him or his designated beneficiary, or upon his death or termination as a lump sum amount equal to the excess of his accumulated contributions over any benefits paid on his behalf.

Effective July 1, 1981, the System became non-contributory (or, for classes of employees who previously contributed more than 5%, contribution rates were reduced by 5%) for State employees and for teachers in higher education. Teachers in grades K-12 and political subdivisions remained contributory, except that political subdivisions were given the option of electing to become non-contributory.

For employees who moved from "contributory" to "non-contributory" on July 1, 1981, withdrawals in the event of termination have been calculated as though their personal contributions had continued, and retirement benefits have been calculated by loading each of the next 15 years' salaries by 3.6%. This provision, which otherwise would have expired on June 30, 1996, has been extended permanently effective July 1, 1998 by the Legislature for those members in the system at the onset of non-contributory retirement.

The following summaries give the main provisions of the Tennessee Consolidated Retirement System on which the valuation was based. Summaries are also given of the various superseded systems, whose provisions are applicable for certain members. Throughout these summaries, the symbol # means that the actual benefit (or minimum or maximum) is 105% of the indicated amount for State employees (including teachers) in these categories, and that participating political subdivisions may elect this improvement as an optional provision.

TCRS pension reform was adopted during the 2013 legislative session that created a new hybrid pension plan for participants hired on or after July 1, 2014 (including different defined benefit formulas, a defined contribution component, cost control features and a stabilization reserve fund). The Legacy Plan was closed to new entrants effective June 30, 2014 but continues to accrue benefits for future service earned by all employees already participating in the Legacy Plan as described in this section.

Note: In the following tables, minimum benefits are described as \$96.00 per year or \$103.92 per year for various classifications. These amounts apply to members with at least 10 years of creditable service. If a benefit is calculated for a member with less than 10 years of creditable service, minimum benefits of \$84.00 per year and \$91.92 per year, respectively, apply instead of the amounts shown in the tables.

TENNESSEE CONSOLIDATED RETIREMENT SYSTEM

	GROUP			
	I	II	III	IV
<u>SERVICE RETIREMENT</u>				
<u>Full Benefit:</u>				
Eligibility conditions (Age and years of creditable service)	Age 60 and vested, or 30 years	Age 60 and vested, or 55 with 25 years or 30 years of service*	Age 65 and vested, or age 55 with 24 years or 30 years	Age 55 with 24 years, or Age 60 with 8 years
Benefit percentages (% of AFC for each year of Creditable service):				
% up to SSIL	1.50%#	1.75%#	2.00%	2.50%
% over SSIL	1.75#	2.25#	2.50	2.50
<u>Early Reduced Benefit:</u>				
Eligibility conditions	N/A	55 with 10 years	Age 55 with 8 years	N/A
Benefit	Full benefit reduced by 4/10 of 1% for each month prior to eligibility for full benefit.			
<u>25 Year Benefit:</u>				
Eligibility Conditions	25 years	N/A	N/A	N/A
Benefit	Full benefit is reduced 4/10 of 1% for each of first 60 months prior to 30 years of service. Benefit so calculated is further reduced by actuarial factor if member's age at commencement of benefits is less than 55.			

*See note on next page.

#See explanation on page G-3.

TENNESSEE CONSOLIDATED RETIREMENT SYSTEM
(Continued)

	GROUP			
	I	II	III	IV
<u>Vested Benefit:</u>				
Eligibility conditions	5 years**	10 years	8 years	8 years
Benefit	Reduced benefit payable at age 55 or later Benefit further reduced by 15% for each year of service less than 10 years			
<u>Maximum Benefit:</u> (before reduction)	90%# of average final compensation	80%	75%	75%
<u>Minimum Benefit:</u>	\$96.00# for each year of creditable service, but not in excess of 100% of average final compensation.			

ORDINARY DISABILITY RETIREMENT

Eligibility conditions	5 years	5 years	8 years	8 years
Benefit percentages:*				
% up to SSIL	1.350%#	1.575%#	1.800%	2.250%
% over SSIL	1.575#	2.025#	2.250	2.250

* Benefit % for each year of creditable service. If service to date of disability retirement is less than 20 years, projected years of service to the full benefit date are added to creditable service, but not to bring total years of creditable service to more than 20 years, nor less than ten years of creditable service. Benefit changes to normal service benefit (including projected years of service) when the conditions for normal service retirement are met.

NOTE: During certain time restricted periods, certain Group II members could elect to become covered by a special provision whereby the eligibility condition for service retirement is age 55 (and vested) or 25 years of service. In order to elect this provision of the law, the Group II member must make additional contributions to the retirement system at the rate of 5% of salary.

**If membership date is prior to 7-1-79, 4 years.

TENNESSEE CONSOLIDATED RETIREMENT SYSTEM
(Continued)

	GROUP			
	I	II	III	IV

ORDINARY DISABILITY RETIREMENT (Continued)

<u>Maximum Benefit:</u>	75%# of average final compensation
<u>Minimum Benefit:</u> (no reduction)	\$96.00# for each year of creditable service to date of disability retirement, but not in excess of 100% of final compensation.

ACCIDENTAL DISABILITY RETIREMENT

Eligibility condition	In performance of duty	In performance of duty	N/A	N/A
Benefit:				
To age 62 or receipt of Social Security Disability	50%# of average final compensation	50%# of average final compensation	N/A	N/A
After age 62 or receipt of Social Security Disability	33-1/3%# of average final compensation	33-1/3%# of average final compensation	N/A	N/A

For members joining on or after 7/1/97, benefit is determined in same manner as ordinary disability.

INACTIVE DISABILITY

Eligibility condition	5 years	5 years	8 years	8 years
Benefit:	Actuarial equivalent of age 55 benefit			

ORDINARY DEATH BENEFITS

1. Eligibility condition	Eligible for early or service retirement benefit
Benefit	Survivor benefit as if member had retired and elected joint and 100% survivor annuity

TENNESSEE CONSOLIDATED RETIREMENT SYSTEM
(Continued)

	GROUP			
	I	II	III	IV
<u>ORDINARY DEATH BENEFITS (Continued)</u>				
2. Eligibility condition*	10 years	10 years	10 years	10 years
Benefit	To surviving spouse, as if member had retired and elected immediate joint and 100% survivor annuity (Option I)			
3. Eligibility condition	In service within 150 days and no other benefit			
Benefit	Lump sum equal to the member's account balance plus an equal amount payable from the employer fund.			

ACCIDENTAL DEATH BENEFITS

Eligibility condition: Death in performance of duty
 Benefit: 50% of average final compensation to eligible dependent(s). The aggregate total death benefit payable on account of a member who dies in the line of duty shall have a value of not less than \$50,000. If the death benefit is payable to a single beneficiary, the guaranteed minimum value shall be paid in monthly installments calculated on a sixty-month basis.

If no surviving spouse exists on the date of the member's death and if the projected payments to be made to all the minor children do not exceed a minimum total value of \$50,000 the projected excess shall be paid to the member's estate for the benefit of all the member's surviving children regardless of age. (All death benefits are assumed to be ordinary death benefits for valuation purposes.)

INACTIVE DEATH BENEFITS

Eligibility condition*	10 years	10 years	10 years	10 years
Benefit	To surviving spouse as if member had retired and elected Option II (50%)			

* Optional to political subdivisions

TENNESSEE CONSOLIDATED RETIREMENT SYSTEM
(Continued)

	GROUP			
	I	II	III	IV
<u>MEMBER CONTRIBUTION RATES</u>				
<u>Contributory</u>				
% of compensation up to SSB	5.0%	5.5%	5.5%	N/A
% of compensation in excess of SSB	5.0%	5.5%	7.0%	N/A
<u>Non-Contributory</u>				
% of compensation up to SSB	0.0%	0.5%	0.5%	0.5%
% of compensation in excess of SSB	0.0%	0.5%	2.0%	2.0%

SUPERSEDED SYSTEMS
 TENNESSEE TEACHERS' RETIREMENT SYSTEM

	PRIOR CLASS A	TRANSFERRED CLASS B	PRIOR CLASS B
<u>SERVICE RETIREMENT</u>			
<u>Full Benefit:</u>			
Eligibility conditions (Age and years of creditable service)	----- Age 60 or 30 years -----		
Benefit percentages (% of AFC for each year of creditable service):			
% up to SSB	1.125%#	1.875%#	1.875%#
% over SSB	1.875#	1.875#	1.875#
<u>Vested Benefit:</u>			
Eligibility conditions	10 years or 4 years at higher learning institute (only Class A)		
Benefit	Full benefit deferred to age 60		
<u>Minimum Benefit</u> (No reduction)	\$96.00#	\$103.92#	\$103.92#
<u>DISABILITY RETIREMENT</u>			
Eligibility conditions	10 years	10 years	10 years
Benefit percentages:			
% up to SSB	1.0125%*#	1.6875%* **#	1.6875%* **#
% over SSB	1.6875#	1.6875#	1.6875#
<u>Minimum Benefit</u> (No reduction)	\$96.00#	\$103.92#	\$103.92#

* If service to date of disability retirement is less than 20 years, projected years of service to the full benefit date are added to creditable service, but not to bring total years of creditable service to more than 20 years, nor less than 10 years.

** Total benefit package percentage based on years of service not to be less than 25%.#

SUPERSEDED SYSTEMS

TENNESSEE TEACHERS' RETIREMENT SYSTEM
(Continued)

	PRIOR CLASS A	TRANSFERRED CLASS B	PRIOR CLASS B
<u>DEATH BENEFITS</u>			
1. Eligibility condition	Eligible for early or service retirement		
Benefit	Joint and 100% survivor option as if member had retired and elected this option		
2. Eligibility condition	10 years	10 years	10 years
Benefit	To surviving spouse, as if member had retired and elected immediate joint and 100% survivor annuity (Option I)		
3. Eligibility condition	In service within 120 days and no other benefit		
Benefit	Lump sum equal to the member's account balance plus an equal amount payable from the employer fund		
<u>INACTIVE DEATH BENEFITS</u>			
Eligibility condition*	10 years	10 years	10 years
Benefit	To surviving spouse as if member had retired and elected Option II (50%)		
<u>MEMBER CONTRIBUTION RATES</u>			
<u>Contributory</u>			
% of compensation up to SSB	3.0%	5.0%	7.0%
% of compensation in excess of SSB	3.0%	5.0%	7.0%
<u>Non-Contributory</u>	0.0%	0.0%	2.0%

*Optional to political subdivisions

SUPERSEDED SYSTEMS

TENNESSEE STATE RETIREMENT SYSTEM

GENERAL EMPLOYEES			
	PRIOR CLASS A	TRANSFERRED CLASS B	PRIOR CLASS B
<u>SERVICE RETIREMENT</u>			
<u>Full Benefit:</u>			
Eligibility conditions (Age and years of creditable service)	Age 65	Age 60 with 20 years or 30 years	Age 60 with 20 years or 30 years
Benefit percentages (% of AFC for each year of creditable service):			
% up to SSB	1.125%#	1.875%#	1.875%#
% over SSB	1.750#	1.875#	1.875#
<u>Vested Benefit:</u>			
Eligibility conditions	10 years	10 years	10 years
	Payable at age 55 or later		
Benefit	Full benefit reduced by 4/10 of 1% for each month prior to eligibility for full benefit		
<u>Maximum Benefit:</u>	75%# of average final compensation		
<u>Minimum Benefit:</u>			
(Per year of creditable service) No reduction	\$96.00#	\$103.92#	\$103.92#
<u>Death Benefits:</u>			
1. Eligibility condition	Eligible for early or service retirement		
Benefit	Joint and 100% survivor option as if member had retired and elected this option.		
2. Eligibility condition*	10 years	10 years	10 years
Benefit	To surviving spouse, as if member had retired and elected immediate joint and 100% survivor annuity (Option I)		
* Optional to political subdivisions.			

SUPERSEDED SYSTEMS

TENNESSEE STATE RETIREMENT SYSTEM
(Continued)

				GENERAL EMPLOYEES		
		PRIOR CLASS A	TRANSFERRED CLASS B	PRIOR CLASS B		
3.	Eligibility condition	In service within 120 days and no other benefit				
	Benefit	Lump sum equal to the member's account balance plus an equal amount payable from the employer fund.				
<u>INACTIVE DEATH BENEFITS</u>						
	Eligibility condition***	10 years	10 years	10 years		
	Benefit	To surviving spouse as if member had retired and elected Option II (50%)				
<u>DISABILITY RETIREMENT</u>						
	Eligibility conditions	10 years	5 years	5 years		
	Benefit percentages:					
	% up to SSB	1.0125%**	1.6875%***	1.6875%***		
	% over SSB	1.5750#	1.6875#	1.6875#		
	<u>Maximum Benefit</u>	75% of average final compensation				
	<u>Minimum Benefit</u> (No reduction)	\$96.00#	\$103.92#	\$103.92#		
<u>MEMBER CONTRIBUTION RATES</u>						
<u>Contributory</u>						
	% of compensation up to SSB	3.0%	5.5%	7.0%		
	% of compensation in excess of SSB	5.0%	5.5%	7.0%		
	<u>Non-Contributory</u>	0.0%	0.0%	2.0%		
*	If service to date of disability retirement is less than 20 years, projected years of service to the full benefit date are added to creditable service, but not to bring total years of creditable service to more than 20 years.					
**	Total benefit percentage based on years of service not to be less than 25%.#					
***	Optional to political subdivisions					

SUPERSEDED SYSTEMS

TENNESSEE STATE RETIREMENT SYSTEM
(Continued)

	GAME AND FISH OFFICERS	STATE POLICEMEN	FIREMEN AND POLICEMEN
<u>SERVICE RETIREMENT</u>			
<u>Full Benefit:</u>			
Eligibility conditions (Age and years of creditable service)	Age 60 or 55 with 25 years, or 30 years	Age 50 or 25 years	Age 55 with 25 years, or 30 years
Benefit percentages (% of AFC for each year of creditable service)	2.125%#	2.250%#	2.250%#
<u>Vested Benefit:</u>			
Eligibility conditions	10 years	10 years	10 years
	Payable at age 55 or later for Class A Payable upon completion of 10 years for Class B		
Benefit	Full benefit reduced by 4/10 of 1% for each month prior to eligibility for full benefit		
<u>Maximum Benefit</u>	75%# of average final compensation		
<u>Minimum Benefit</u> (Per year of creditable service)	Class A - \$96.00# Class B - \$103.92#	N/A	Class A - \$96.00# Class B - \$103.92#
<u>DISABILITY RETIREMENT</u>			
Eligibility conditions	Class A - 10 years Class B - 5 years	5 years	Class A - 10 years Class B - 5 years
Benefit percentages	1.9125%**	2.025%**	2.025%**
<u>Maximum Benefit</u>	75% of average final compensation		
<u>Minimum Benefit</u> (No projected service)	Class A - \$96.00# Class B - \$103.92#	N/A	Class A - \$96.00# Class B - \$103.92#

* For Class A, if service to date of disability retirement is less than 20 years, projected years of service to age 55 are added to creditable service, but not to bring total years of creditable service to more than 20 years. Class B does not get projected years.

** Total benefit percentage based on years of service (without projection) not to be less than 25%.#

SUPERSEDED SYSTEMS

TENNESSEE STATE RETIREMENT SYSTEM
(Continued)

	GAME AND FISH OFFICERS	STATE POLICEMEN	FIREMEN AND POLICEMEN
<u>ACCIDENTAL DISABILITY</u>			
Eligibility conditions	N/A	In performance of duty	N/A
Benefit	N/A	50% of AFC#	N/A
<u>ORDINARY DEATH BENEFITS</u>			
1. Eligibility conditions	In service within 120 days and no other benefit		
Benefit	Lump sum equal to the member's account balance plus an equal amount payable from the employer fund.		
2. Eligibility conditions*	10 years	10 years	10 years
Benefit	To surviving spouse, as if member had retired and elected immediate joint and 100% survivor annuity (Option I)		
3. Eligibility conditions	Eligible for early or service retirement		
Benefit	Joint and 100% survivor option as if member had retired and elected this option.		
<u>INACTIVE DEATH BENEFITS</u>			
Eligibility condition	10 years	10 years	10 years
Benefit	To surviving spouse as if member had retired and elected Option II (50%)		
<u>DEATH IN PERFORMANCE OF DUTY</u>	N/A	50% of AFC#	N/A
(All death benefits are assumed to be ordinary death benefits for valuation purposes.)			
<u>MEMBER CONTRIBUTION RATES</u>			
% of compensation to SSB	5.0%	6.63%	Class A - 3.0% Class B - 7.0%
% of compensation in excess of SSB	5.0%	6.63%	Class A - 5.0% Class B - 7.0%
*Optional to political subdivisions.			

SUPERSEDED SYSTEMS

	STATE JUDGES	ATTORNEYS GENERAL	COUNTY JUDGES
<u>SERVICE RETIREMENT</u>			
<u>Full Benefit:</u>			
Eligibility conditions (Age and years of service)	Age 65 or age 54 with 8 years	Age 54 with 10 years	Age 55 with 8 years
Benefit percentages (% of BB for each year of creditable service)	3.75%	3.75%	3.0%*
<u>Vested Benefit:</u>			
Eligibility conditions	Immediate	10 years	8 years
Benefit	Full benefit deferred to age 54 with 8 years or age 65	Full benefit deferred to age 54	Full benefit deferred to age 55
<u>Maximum Benefit</u>	75% of BB	75% of BB	75% of BB
<u>DISABILITY RETIREMENT</u>			
Eligibility conditions	10 years	10 years	8 years
Benefit	Full service benefit	Full service benefit	Full service benefit
<u>Minimum Benefit</u>	N/A	N/A	25% of AFC

BB (Benefit Base) definition:

- (1) If member's benefit is subject to escalation, the BB is the salary the retired member would have received had he remained in office.
- (2) If member's benefit is not subject to escalation, the BB is the salary at the time the member retired or the salary in effect May 1, 1975, whichever is greater.

* Minimum total rate of 75% of average final compensation after 24 years of creditable service.

SUPERSEDED SYSTEMS
(Continued)

	STATE JUDGES	ATTORNEYS GENERAL	COUNTY JUDGES
<u>DEATH BENEFIT</u>			
Eligibility conditions			
1. Eligible for service retirement	If elected, survivorship option as if member retired; otherwise 100% joint and survivor option to designated beneficiary	If elected, survivorship option as if member retired; otherwise 100% joint and survivor option to designated beneficiary	If elected, survivorship option as if member retired; otherwise 50% joint and survivor option to designated beneficiary
2. Eligibility conditions	10 years	10 years	10 years
Benefit	To surviving spouse, as if member had retired and elected immediate joint and 100% survivor annuity (Option I)		
3. 10 years	N/A	Optional benefit paid at age 54 if elected	N/A
4. Age 54 with 10 years or 18 years	N/A	50% joint and survivor option as if member had retired	N/A
5. Eligibility condition	In service within 120 days and no other benefit		
Benefit	Lump sum equal to the member's account balance plus an equal amount payable from the employer fund.		
<u>INACTIVE DEATH BENEFITS</u>			
Eligibility condition	10 years	10 years	10 years
Benefit	To surviving spouse as if member had retired and elected Option II (50%)		
<u>MEMBER CONTRIBUTION RATES</u>			
	3.0%	8.0% contributory 3.0% non-contributory	8.0% contributory 3.0% non-contributory

SUPERSEDED SYSTEMS
(Continued)

	COUNTY OFFICIALS	PUBLIC SERVICE COMMISSIONERS
<u>SERVICE RETIREMENT</u>		
<u>Full Benefit:</u>		
Eligibility conditions (Age and years of service)	Age 55 with 12 years	Age 65 or age 54 with 12 years
Benefit percentages (% of BB or AFC for each year of creditable service)	2.5% of AFC	3.75% of salary at retirement
<u>Maximum Benefit</u>	75% of AFC	75% of salary at retirement
<u>Vested Benefit:</u>		
Eligibility conditions	12 years	Immediate
Benefit	Full benefit deferred to age 55	Deferred to age 65 or to age 54 with 12 years
<u>DISABILITY RETIREMENT</u>		
Eligibility conditions	N/A	10 years
Benefit	N/A	Full benefit
<u>DEATH BENEFITS</u>		
1. Eligibility conditions	12 years	Eligible for full benefit
Benefit	Full benefit payable to beneficiary for 10 years; if eligible for service retirement, beneficiary may elect joint and 100% survivor option	If elected, survivorship option as if member retired; otherwise 100% joint and survivor option to designated beneficiary
2. Eligibility conditions	10 years	10 years
Benefit	To surviving spouse, as if member had retired and elected immediate joint and 100% survivor annuity (Option I)	
3. Eligibility condition	In service within 120 days and no other benefit	
Benefit	Lump sum equal to the member's account balance plus an equal amount payable from the employer fund.	

SUPERSEDED SYSTEMS
(Continued)

	COUNTY OFFICIALS	PUBLIC SERVICE COMMISSIONERS
<u>INACTIVE DEATH BENEFITS</u>		
1. Eligibility conditions	10 years	10 years
Benefit	To surviving spouse as if member had retired and elected Option II (50%)	
2. Eligibility conditions	Out of service more than 120 days	
Benefit	Lump sum payment equal to member's account balance	
<u>MEMBER CONTRIBUTION RATES</u>		
	8.0%	8.0%

H. APPENDIX

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TABLE I-1
 CONTRIBUTORY TEACHERS
 DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
 BY AGE

Age Group	Number	Earnings	
		Total	Average
1-20	0	\$0	\$0
21-25	17	680,234	40,014
26-30	4,006	183,528,826	45,813
31-35	7,834	395,013,119	50,423
36-40	9,407	523,253,250	55,624
41-45	10,305	613,586,809	59,543
46-50	10,435	643,353,163	61,653
51-55	7,437	459,936,191	61,844
56-60	5,921	371,927,372	62,815
61-65	3,188	206,682,805	64,831
66-70	760	50,960,825	67,054
71-75	153	10,117,279	66,126
76-80	20	1,401,563	70,078
81-85	4	222,576	55,644
86-90	0	0	0
Total	59,487	\$3,460,664,012	\$58,175

TABLE I-2
 STATE GENERAL EMPLOYEES
 (INCLUDES NON-CONTRIBUTORY TEACHERS AND SEPARATELY-FUNDED SYSTEMS)
 DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
 BY AGE

Age Group	Number	Earnings	
		Total	Average
1-20	1	\$4,145	\$4,145
21-25	103	3,391,049	32,923
26-30	1,654	72,871,197	44,058
31-35	3,009	147,264,362	48,941
36-40	4,261	219,736,125	51,569
41-45	5,013	271,628,181	54,185
46-50	5,855	324,842,004	55,481
51-55	6,639	365,276,873	55,020
56-60	6,777	370,950,747	54,737
61-65	4,746	268,912,745	56,661
66-70	1,751	112,329,038	64,151
71-75	578	35,594,117	61,582
76-80	138	7,960,657	57,686
81-85	39	2,105,746	53,993
86-90	0	0	0
Total	40,564	\$2,202,866,986	\$54,306

TABLE I-3
POLITICAL SUBDIVISION GENERAL EMPLOYEES
DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY AGE

Age Group	Number	Earnings	
		Total	Average
1-20	415	\$11,599,838	\$27,951
21-25	3,677	111,553,350	30,338
26-30	6,209	204,738,597	32,974
31-35	6,742	236,336,970	35,054
36-40	8,047	284,665,322	35,375
41-45	9,329	341,026,650	36,556
46-50	11,444	423,279,818	36,987
51-55	11,774	426,859,907	36,254
56-60	11,075	394,801,980	35,648
61-65	7,346	261,660,397	35,619
66-70	2,762	88,869,481	32,176
71-75	1,138	34,492,335	30,310
76-80	361	9,441,030	26,152
81-85	110	3,025,559	27,505
86-90	0	0	0
Total	80,429	\$2,832,351,234	\$35,216

TABLE I-4
 UNIVERSITY OF TENNESSEE (TIAA)
 DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
 BY AGE

Age Group	Number	Earnings	
		Total	Average
1-20	0	\$0	\$0
21-25	0	0	0
26-30	0	0	0
31-35	0	0	0
36-40	0	0	0
41-45	0	0	0
46-50	0	0	0
51-55	0	0	0
56-60	0	0	0
61-65	3	445,643	148,547
66-70	11	1,779,893	161,808
71-75	16	2,027,267	126,704
76-80	8	1,031,664	128,958
81-85	4	475,235	118,808
86-90	0	0	0
Total	42	\$5,759,702	\$137,136

TABLE I-5

GROUP II

DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY AGE

Age Group	Number	Earnings	
		Total	Average
1-20	0	\$0	\$0
21-25	0	0	0
26-30	0	0	0
31-35	0	0	0
36-40	0	0	0
41-45	0	0	0
46-50	0	0	0
51-55	0	0	0
56-60	1	89,648	89,648
61-65	2	204,701	102,350
66-70	1	74,906	74,906
71-75	0	0	0
76-80	0	0	0
81-85	0	0	0
86-90	0	0	0
Total	4	\$369,255	\$92,314

TABLE I-6

GROUP III

DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY AGE

Age Group	Number	Earnings	
		Total	Average
1-20	0	\$0	\$0
21-25	0	0	0
26-30	0	0	0
31-35	0	0	0
36-40	0	0	0
41-45	0	0	0
46-50	0	0	0
51-55	0	0	0
56-60	0	0	0
61-65	0	0	0
66-70	0	0	0
71-75	0	0	0
76-80	1	156,024	156,024
81-85	4	353,422	88,355
86-90	0	0	0
Total	5	\$509,446	\$101,889

TABLE I-7

TOTAL

DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY AGE

Age Group	Number	Earnings	
		Total	Average
1-20	416	\$11,603,983	\$27,894
21-25	3,797	115,624,633	30,452
26-30	11,869	461,138,620	38,852
31-35	17,585	778,614,451	44,277
36-40	21,715	1,027,654,697	47,325
41-45	24,647	1,226,241,640	49,752
46-50	27,734	1,391,474,985	50,172
51-55	25,850	1,252,072,971	48,436
56-60	23,774	1,137,769,747	47,858
61-65	15,285	737,906,291	48,276
66-70	5,285	254,014,143	48,063
71-75	1,885	82,230,998	43,624
76-80	528	19,990,938	37,862
81-85	161	6,182,538	38,401
86-90	0	0	0
Total	180,531	\$8,502,520,635	\$47,097

TABLE II-1
 CONTRIBUTORY TEACHERS
 DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
 BY LENGTH OF SERVICE

Service Group	Number	Earnings	
		Total	Average
0	57	\$3,225,357	\$56,585
1	87	5,033,891	57,861
2	32	1,649,934	51,560
3	55	3,155,084	57,365
4	3,417	164,208,498	48,056
0-4	3,648	177,272,764	48,595
5-9	13,985	711,063,269	50,845
10-14	13,446	759,423,267	56,479
15-19	11,314	694,929,254	61,422
20-24	8,378	539,929,836	64,446
25-29	4,823	315,725,672	65,463
30-34	2,482	165,243,552	66,577
35-39	985	66,239,523	67,248
40-44	326	23,497,200	72,077
45-49	100	7,339,675	73,397
Total	59,487	\$3,460,664,012	\$58,175

TABLE II-2
 STATE GENERAL EMPLOYEES
 (INCLUDES NON-CONTRIBUTORY TEACHERS AND SEPARATELY-FUNDED SYSTEMS)
 DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
 BY LENGTH OF SERVICE

Service Group	Number	Earnings	
		Total	Average
0	54	\$3,714,314	\$68,784
1	91	5,748,100	63,166
2	61	3,932,740	64,471
3	57	4,541,969	79,684
4	2,667	131,022,492	49,127
0-4	2,930	148,959,615	50,839
5-9	8,877	450,179,731	50,713
10-14	9,054	471,565,441	52,084
15-19	6,698	354,089,987	52,865
20-24	4,787	271,124,688	56,638
25-29	3,430	206,859,024	60,309
30-34	2,863	174,508,891	60,953
35-39	1,235	77,297,089	62,589
40-44	540	37,153,989	68,804
45-49	150	11,128,531	74,190
Total	40,564	\$2,202,866,986	\$54,306

TABLE II-3

POLITICAL SUBDIVISION GENERAL EMPLOYEES
DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY LENGTH OF SERVICE

Service Group	Number	Earnings	
		Total	Average
0	8,439	\$244,931,333	\$29,024
1	6,999	197,680,124	28,244
2	5,424	157,034,247	28,952
3	4,737	145,341,951	30,682
4	3,885	122,931,259	31,643
0-4	29,484	867,918,914	29,437
5-9	13,781	455,737,960	33,070
10-14	13,036	468,465,195	35,936
15-19	9,882	389,204,112	39,385
20-24	6,965	297,664,890	42,737
25-29	3,941	183,636,766	46,596
30-34	2,150	105,167,075	48,915
35-39	799	42,295,677	52,936
40-44	315	17,695,408	56,176
45-49	76	4,565,237	60,069
Total	80,429	\$2,832,351,234	\$35,216

TABLE II-4

UNIVERSITY OF TENNESSEE (TIAA)

DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY LENGTH OF SERVICE

Service Group	Number	Earnings	
		Total	Average
0	0	\$0	\$0
1	0	0	0
2	1	109,741	109,741
3	0	0	0
4	0	0	0
0-4	1	109,741	109,741
5-9	0	0	0
10-14	0	0	0
15-19	0	0	0
20-24	0	0	0
25-29	0	0	0
30-34	0	0	0
35-39	1	123,554	123,556
40-44	30	4,076,984	135,899
45-49	10	1,449,423	144,942
Total	42	\$5,759,702	\$137,136

TABLE II-5

GROUP II

DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY LENGTH OF SERVICE

Service Group	Number	Earnings	
		Total	Average
0	0	\$0	\$0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
0-4	0	0	0
5-9	0	0	0
10-14	0	0	0
15-19	0	0	0
20-24	0	0	0
25-29	0	0	0
30-34	1	113,018	113,018
35-39	0	0	0
40-44	2	181,331	90,665
45-49	1	74,906	74,906
Total	4	\$369,255	\$92,314

TABLE II-6

GROUP III

DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY LENGTH OF SERVICE

Service Group	Number	Earnings	
		Total	Average
0	0	\$0	\$0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
0-4	0	0	0
5-9	0	0	0
10-14	0	0	0
15-19	0	0	0
20-24	0	0	0
25-29	0	0	0
30-34	0	0	0
35-39	0	0	0
40-44	1	117,339	117,339
45-49	4	392,107	98,026
Total	5	\$509,446	\$101,889

TABLE II-7

TOTAL

DISTRIBUTION OF ACTIVE PARTICIPANTS' EARNINGS
BY LENGTH OF SERVICE

Service Group	Number	Earnings	
		Total	Average
0	8,550	\$251,871,004	\$29,459
1	7,177	208,462,115	29,046
2	5,518	162,726,662	29,490
3	4,849	153,039,004	31,561
4	9,969	418,162,249	41,946
0-4	36,063	1,194,261,034	33,116
5-9	36,643	1,616,980,960	44,128
10-14	35,536	1,699,453,903	47,823
15-19	27,894	1,438,223,353	51,560
20-24	20,130	1,108,719,414	55,078
25-29	12,194	706,221,462	57,915
30-34	7,496	445,032,536	59,369
35-39	3,020	185,955,843	61,575
40-44	1,214	82,722,251	68,140
45-49	341	24,949,879	73,167
Total	180,531	\$8,502,520,635	\$47,097

TABLE III
 DISTRIBUTION OF CURRENT BENEFITS BY AGE GROUPS
 RETIRED LIVES

Age Group	Number	Annual Benefit	
		Total	Average
1-20	0	\$0	\$0
21-25	0	0	0
26-30	3	17,996	5,999
31-35	10	101,378	10,138
36-40	56	514,027	9,179
41-45	153	1,370,335	8,956
46-50	447	4,442,080	9,938
51-55	2,469	37,063,298	15,011
56-60	10,903	173,834,983	15,944
61-65	28,006	438,103,241	15,643
66-70	39,253	664,841,705	16,937
71-75	30,800	536,856,245	17,430
76-80	19,772	332,041,117	16,794
81-85	12,833	210,542,782	16,406
86-90	12,658	180,596,756	14,267
Total	157,363	\$2,580,325,943	\$16,397

TABLE IV
 DISTRIBUTION OF CURRENT BENEFITS BY YEARS SINCE RETIREMENT
 RETIRED LIVES

Years Since Retirement	Number	Annual Benefit	
		Total	Average
0	5,607	\$85,208,280	\$15,197
1	8,667	128,246,192	14,797
2	9,660	148,630,527	15,386
3	10,077	146,403,771	14,529
4	9,379	152,567,926	16,267
0- 4	43,390	661,056,767	15,235
5-9	40,164	682,053,803	16,982
10-14	28,496	490,348,130	17,208
15-19	20,547	360,185,465	17,530
20-24	13,151	219,003,357	16,653
25-29	6,875	108,460,510	15,776
30-34	3,063	41,445,904	13,531
35-39	1,236	13,707,839	11,090
40-44	330	3,203,860	9,709
45-49	111	860,308	7,751
Total	157,363	\$2,580,325,943	\$16,397

TABLE V-1

MARKET VALUE OF ASSETS – ASSET ALLOCATION
June 30, 2018

Asset Class	Allocation
Domestic Equity	31.0%
Domestic Fixed Income	29.4%
International Equity	14.8%
International Fixed Income	0.1%
Short-Term Securities	5.8%
Real Estate	9.0%
Private Equity & Strategic Lending	9.9%
Total	100.0%

Note: The above breakdown was provided by the TCRS.

TABLE V-2
CHANGE IN MARKET VALUE OF ASSETS
June 30, 2018

	Contributory	Consolidated	State Judges & Attorneys- General	Polisubs	Grand Total
	Teachers	State			
Market Value of Assets at June 30, 2017	\$22,890,832,724	\$13,837,873,285	\$445,918,811	\$9,617,790,972	\$46,792,415,792
Employer Contributions	317,951,320	420,449,557	18,822,715	271,984,874	1,029,208,466
Employee Contributions	176,712,880	172,132	233,406	84,526,705	261,645,123
Investment Income	1,867,641,142	1,131,235,554	36,683,602	795,216,591	3,830,776,889
Benefit Payments	(1,200,527,189)	(886,660,202)	(26,849,047)	(406,469,991)	(2,520,506,429)
Refunds of Employee Contributions	(18,334,388)	(490,770)	(63,370)	(17,686,886)	(36,575,414)
Administrative Expense	(5,749,187)	(3,863,726)	(66,665)	(7,592,734)	(17,272,312)
Net Transfers	(3,843)	(103,848)	(35,131)	142,822	0
Market Value of Assets at June 30, 2018	\$24,028,523,459	\$14,498,611,982	\$474,644,321	\$10,337,912,353	\$49,339,692,115

Net transfers within a given year may not reconcile to zero due to timing.

TABLE V-3
 HISTORY OF INVESTMENT RETURNS
June 30, 2018

Year Ending	Investment Return
June 30, 2018	8.19 %
June 30, 2017	11.42
June 30, 2016	2.79
June 30, 2015	3.33
June 30, 2014	16.65
June 30, 2013	9.92
June 30, 2012	5.61
June 30, 2011	19.59
June 30, 2010	10.24
June 30, 2009	(15.27)
June 30, 2008	(1.21)
June 30, 2007	13.15
June 30, 2006	6.94
June 30, 2005	7.30
June 30, 2004	9.32
June 30, 2003	4.90
June 30, 2002	(1.92)
June 30, 2001	(1.57)
June 30, 2000	7.91
June 30, 1999	9.47

Note: The above investment returns are on a market value basis.

TABLE V-4

ACTUARIAL VALUE OF ASSETS

June 30, 2018

Year Ending	Actual Investment Return	Expected Investment Return	Excess Income Base	Recognized as of June 30, 2018	Deferred as of June 30, 2018
June 30, 2018	\$3,830,776,889	\$3,345,923,249	\$484,853,640	\$48,485,364	\$436,368,276
June 30, 2017	4,826,376,132	3,194,464,519	1,631,911,613	326,382,322	1,305,529,291
June 30, 2016	1,131,293,590	3,198,952,742	(2,067,659,152)	(620,297,745)	(1,447,361,407)
June 30, 2015	1,306,179,721	3,180,729,134	(1,874,549,413)	(749,819,764)	(1,124,729,649)
June 30, 2014	6,203,093,548	2,786,652,754	3,416,440,794	1,708,220,395	1,708,220,399
June 30, 2013	3,382,126,742	2,592,507,858	789,618,884	473,771,328	315,847,556
June 30, 2012	1,834,485,860	2,504,100,892	(669,615,032)	(468,730,521)	(200,884,511)
June 30, 2011	5,560,368,166	2,126,617,957	3,433,750,209	2,747,000,168	686,750,041
June 30, 2010	2,724,777,261	1,949,848,310	774,928,951	697,436,055	77,492,896
June 30, 2009	(4,836,986,786)	2,357,334,600	(7,194,321,386)	(7,194,321,386)	0
				Total Deferred Income:	\$1,757,232,892
1. Market Value of Assets				\$49,339,692,115	
2. Total Deferred Income				1,757,232,892	
3. Preliminary Actuarial Value of Assets, (1) - (2)				\$47,582,459,223	
4. Actuarial Value of Assets, (3) but not less than 80% of (1) or greater than 120% of (1)				\$47,582,459,223	
5. Ratio of Actuarial Value to Market Value, (4) / (1)				96.44%	
	Contributory Teachers	Consolidated State	State Judges & Attorneys- General	Polisubs	Grand Total
Market Value of Assets at June 30, 2018	\$24,028,523,459	\$14,498,611,982	\$474,644,321	\$10,337,912,353	\$49,339,692,115
Ratio of Actuarial Value to Market Value	96.44%	96.44%	96.44%	96.44%	96.44%
Actuarial Value of Assets at June 30, 2018	\$23,172,747,714	\$13,982,243,988	\$457,739,866	\$9,969,727,655	\$47,582,459,223

TABLE VI-1

AMOUNTS TO BE AMORTIZED

CALCULATION OF UNFUNDED ACCRUED LIABILITY

June 30, 2018

	Contributory Teachers	Consolidated State	State Judges & Attorneys General
1. Entry Age Past Service Liability	23,676,631,927	16,033,273,979	555,394,340
2. Valuation Assets	23,172,747,714	13,982,243,988	457,739,866
3. Unfunded Accrued Liability ((1)-(2))	503,884,213	2,051,029,991	97,654,474

TABLE VI-2

AMOUNTS TO BE AMORTIZED

SCHEDULE OF PRE-EXISTING UNFUNDED ACCRUED LIABILITY AMORTIZATIONS

June 30, 2018

Date Established	Maximum Remaining Years	Contributory Teachers			Consolidated State			State Judges & Attorneys General		
		Present			Present			Present		
		<u>Value</u>	<u>Years</u>	<u>Amortization</u>	<u>Value</u>	<u>Years</u>	<u>Amortization</u>	<u>Value</u>	<u>Years</u>	<u>Amortization</u>
June 30, 2013	15.00	261,207,327	1.72	155,677,681	980,688,840	9.70	134,513,915	84,309,406	10.33	11,072,584
June 30, 2015	17.00	(349,254,976)	17.00	(33,934,135)	132,372,410	17.00	12,861,501	(1,484,446)	17.00	(144,231)
June 30, 2016	18.00	(22,529,110)	18.00	(2,126,109)	141,240,167	18.00	13,329,066	(1,643,047)	18.00	(155,057)
June 30, 2017	19.00	481,972,047	19.00	44,298,507	701,032,516	19.00	64,432,562	21,440,808	19.00	1,970,645
Total		371,395,288	--	163,915,944	1,955,333,933	--	225,137,044	102,622,721	--	12,743,941

TABLE VI-3
AMOUNTS TO BE AMORTIZED
TOTAL UNFUNDED ACCRUED LIABILITY AMORTIZATION

	Contributory Teachers	Consolidated State	State Judges & Attorneys General
1. Unfunded Accrued Liability (UAL)	503,884,213	2,051,029,991	97,654,474
2. PV of Pre-Existing UAL Amortizations	371,395,288	1,955,333,933	102,622,721
3. New UAL Amortization Base ((1)-(2))	132,488,925	95,696,058	(4,968,247)
4. New UAL Amortization Period	20 years	20 years	20 years
5. New UAL Amortization	11,888,159	8,586,755	(445,798)
6. Pre-Existing UAL Amortizations	163,915,944	225,137,044	12,743,941
7. Total UAL Amortization ((5)+(6))	175,804,103	233,723,799	12,298,143
8. Eligible Payroll	3,460,664,012	2,130,015,266	79,120,868
9. Total UAL Amortization as % of Pay ((7) / (8))	5.08%	10.97%	15.54%

PV = Present Value

TABLE VII
CALCULATION OF CONTRIBUTION RATES

	Contributory Teachers	Consolidated State	State Judges & Attorneys General
1. Normal Cost	172,031,961	168,714,756	7,037,484
2. Eligible Payroll	3,460,664,012	2,130,015,266	79,120,868
3. Normal Cost as % of Pay ((1) / (2))	4.97%	7.92%	8.89%
4. Total UAL Amortization as % of Pay (Table VI-3)	5.08%	10.97%	15.54%
5. Total Contribution Rate ((3)+(4)) x 1.03625 + 0.22%	10.63%	19.80%	25.55%

TABLE VIII

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

The actuarial assumptions and methods set forth below have been selected by the actuary based on results of an actuarial experience study covering the period from July 1, 2012 through June 30, 2016 and expectations regarding future events and economic conditions.

The assumptions and methods were adopted as of June 30, 2017 unless otherwise noted.

Actuarial Funding Method:

(Effective June 30, 2015):

Entry-Age Normal. The funding policy requires unfunded liabilities to be amortized utilizing the level dollar amortization method over a closed period not to exceed 20 years. A tier approach is required for new actuarial gains and losses created from each actuarial valuation. The amortization period of each tier may be shortened or extended from valuation to valuation to manage volatility but the specific tier must be completely amortized within 20 years of its original creation.

Asset Valuation Method:

(Effective prospectively for fiscal years ending after June 30, 2007):

Ten-year moving market value average. Earnings in excess of or below expected investment returns are recognized over a ten year period. In no event will the actuarial value of assets be less than 80% of the market value of assets or greater than 120% of the market value of assets.

Interest Rate:

7.25% per annum, compounded annually

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

Salary Increases:

Salary increase rates vary by age. Sample rates are shown below.

<u>Age</u>	<u>Rate</u>
20	8.72%
30	6.48
40	5.10
50	4.02
60	3.54
65	3.46

Increase in Social Security Wage Base:

3.00% annual increase

Cost of Living Adjustment:

2.25% annual increase in monthly retirement benefits

Inflation:

2.50% annual rate of inflation is assumed in establishing economic assumptions

Marital Status:

(a) Percent married –

Eligible for service retirement – 80%

Ineligible for service retirement – 75%

(b) Age difference – males are assumed to be four years older than spouse

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

Post-Retirement Mortality (Base Rates):

(a) Service Retirement – base rates developed in the 2016 experience study as follows:

1. Teachers and Group III –

Males – 111% of RP-2014 White Collar Mortality Table for Healthy Annuitants

Females – 98% of RP-2014 White Collar Mortality Table for Healthy Annuitants

2. Others –

Males – 102% of RP-2014 Blue Collar Mortality Table for Healthy Annuitants

Females – 97% of RP-2014 Blue Collar Mortality Table for Healthy Annuitants

(b) Disability Retirement – 110% of mortality rates published in IRS Revenue Ruling 96-7 for disabilities occurring before January 1, 1995

Post-Retirement Mortality Improvement:

The mortality tables for service retirement include projected mortality improvement from 2014 to 6 years beyond the valuation date using the most current projection scale published by the Society of Actuaries as of the actuarial valuation date (Scale MP-2017 as of June 30, 2018)

Pre-Retirement Mortality and Mortality Improvement:

RP-2014 Mortality Table for Employees with mortality improvement projected from 2014 to 15 years beyond the valuation date using the most current projection scale published by the Society of Actuaries as of the actuarial valuation date (Scale MP-2017 as of June 30, 2018)

Separations from Service:

Representative values of the assumed annual rates of disability, withdrawal and service retirement for the various membership groups are shown on the following pages.

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

GROUP I

TEACHERS

MALE

Age	Disability	Annual Rate of Withdrawal		
		First Year	Second Year	Later
20	0.01%	18.0%	13.5%	10.0%
25	0.01	18.0	13.5	8.5
30	0.01	18.0	13.5	6.0
35	0.03	18.0	13.5	3.6
40	0.08	18.0	13.5	2.0
45	0.14	18.4	13.5	1.5
50	0.17	19.7	14.2	2.0
55	0.17	22.1	16.8	3.1
60	--	25.5	21.6	4.7
65	--	28.0	23.5	--

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

GROUP I

TEACHERS

FEMALE

Age	Disability	Annual Rate of Withdrawal		
		First Year	Second Year	Later
20	0.01%	18.0%	13.5%	10.5%
25	0.01	18.0	13.5	10.0
30	0.01	18.0	13.5	7.6
35	0.03	18.0	13.5	4.6
40	0.08	18.0	13.5	2.3
45	0.14	18.4	13.5	1.1
50	0.17	19.7	14.2	1.6
55	0.17	22.1	16.8	3.8
60	--	25.5	21.6	5.0
65	--	28.0	23.5	--

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

GROUP I

GENERAL EMPLOYEES

MALE

Age	Disability		Annual Rate of Withdrawal					
	State	Polisubs	First Year		Second Year		Later	
			State	Polisubs	State	Polisubs	State	Polisubs
20	0.06%	0.03%	30.0%	26.2%	24.6%	21.8%	17.8%	13.7%
25	0.06	0.03	25.4	23.0	21.4	19.1	14.4	10.3
30	0.07	0.03	23.0	21.8	18.6	17.9	9.6	7.4
35	0.11	0.03	20.8	20.7	16.1	17.0	5.2	5.1
40	0.16	0.08	18.6	19.2	13.8	15.9	2.6	3.5
45	0.22	0.20	16.5	17.7	12.0	14.1	1.8	2.8
50	0.27	0.38	14.8	17.0	11.1	13.0	2.2	2.8
55	0.27	0.49	15.3	17.4	11.6	13.0	2.6	3.6
60	--	--	17.9	20.4	14.4	14.9	4.3	4.6
65	--	--	24.0	26.3	20.5	19.1	--	--

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

GROUP I

GENERAL EMPLOYEES

FEMALE

Age	Disability		Annual Rate of Withdrawal					
	State	Polisubs	First Year		Second Year		Later	
			State	Polisubs	State	Polisubs	State	Polisubs
20	0.03%	0.03%	30.0%	26.2%	24.6%	21.8%	18.3%	19.6%
25	0.03	0.03	25.4	23.0	21.4	19.1	14.8	15.1
30	0.04	0.03	23.0	21.8	18.6	17.9	10.3	11.1
35	0.06	0.03	20.8	20.7	16.1	17.0	6.3	7.7
40	0.14	0.08	18.6	19.2	13.8	15.9	3.4	5.4
45	0.24	0.20	16.5	17.7	12.0	14.1	2.2	4.1
50	0.33	0.38	14.8	17.0	11.1	13.0	2.3	3.8
55	0.38	0.49	15.3	17.4	11.6	13.0	3.4	4.3
60	--	--	17.9	20.4	14.4	14.9	4.9	5.3
65	--	--	24.0	26.3	20.5	19.1	--	--

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

GROUP II

Age	Disability		Withdrawal	
	Male	Female	Male	Female
20	0.06%	0.03%	7.50%	7.50%
25	0.06	0.03	7.50	7.50
30	0.07	0.04	7.50	7.50
35	0.11	0.06	7.50	7.50
40	0.16	0.14	7.50	7.50
45	0.22	0.24	7.50	7.50
50	0.27	0.33	7.50	7.50
55	0.27	0.38	7.50	7.50
60	--	--	7.50	7.50
65	--	--	--	--

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

GROUP III

Age	Disability		Withdrawal	
	Male	Female	Male	Female
20	0.01%	0.01%	--	--
25	0.01	0.01	--	--
30	0.01	0.01	--	--
35	0.03	0.03	--	--
40	0.08	0.08	--	--
45	0.14	0.14	--	--
50	0.17	0.17	--	--
55	0.17	0.17	--	--
60	--	--	--	--
65	--	--	--	--

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

SERVICE RETIREMENT RATES

The following rates are applied at each age at which a member is eligible for an unreduced service retirement benefit.

<u>Age</u>	MALE				
	<u>Teachers</u>	<u>State</u>	<u>Polisubs</u>	<u>Group II</u>	<u>Group III</u>
50	6.5%	6.0%	9.0%	10.0%	–
51	7.0	6.0	9.0	10.0	8.0%
52	7.0	6.0	9.0	15.0	8.0
53	8.5	6.0	9.0	15.0	8.0
54	9.0	6.5	9.0	20.0	8.0
55	10.0	6.5	9.0	20.0	9.6
56	12.0	7.0	9.0	20.0	9.6
57	12.0	7.0	9.5	20.0	9.6
58	13.0	7.5	9.5	25.0	9.6
59	14.0	8.0	10.0	25.0	9.6
60	15.0	8.5	10.5	30.0	9.6
61	16.0	11.0	15.0	30.0	9.6
62	22.0	16.0	20.0	45.0	20.0
63	16.0	12.0	17.5	35.0	9.6
64	18.0	14.0	17.5	35.0	9.6
65	35.0	22.0	24.0	40.0	20.0
66	16.0	15.5	18.5	40.0	20.0
67	16.0	15.5	16.0	40.0	20.0
68	16.0	15.5	16.0	100.0	20.0
69	16.0	15.5	16.5	100.0	20.0
70	16.0	15.5	18.0	100.0	20.0
71	17.0	15.5	18.0	100.0	100.0
72	17.0	15.5	18.0	100.0	100.0
73	17.0	15.5	18.0	100.0	100.0
74	17.0	15.5	18.0	100.0	100.0
75	100.0	100.0	100.0	100.0	100.0

Additional increments for retirees who have fifteen or more years of service at retirement on or after age 60

8.0%	2.0%	2.0%	na	na
------	------	------	----	----

Additional increments for retirees in the year in which they are first eligible for unreduced retirement prior to age 60

12.5%	7.5%	7.5%	15.0%	na
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TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

SERVICE RETIREMENT RATES

The following rates are applied at each age at which a member is eligible for an unreduced service retirement benefit.

FEMALE					
<u>Age</u>	<u>Teachers</u>	<u>State</u>	<u>Polisubs</u>	<u>Group II</u>	<u>Group III</u>
50	6.5%	7.5%	8.0%	10.0%	–
51	7.0	7.5	8.0	10.0	8.0%
52	8.0	7.5	8.0	15.0	8.0
53	9.0	7.5	8.0	15.0	8.0
54	10.0	7.5	8.0	20.0	8.0
55	10.0	7.5	8.0	20.0	9.6
56	12.0	8.0	9.0	20.0	9.6
57	14.0	8.0	9.5	20.0	9.6
58	14.0	8.0	10.0	25.0	9.6
59	15.0	8.0	11.0	25.0	9.6
60	17.0	9.0	11.0	30.0	9.6
61	20.0	12.0	13.0	30.0	9.6
62	26.0	18.0	18.0	45.0	20.0
63	19.5	12.0	16.0	35.0	9.6
64	24.0	14.0	16.0	35.0	9.6
65	37.5	22.0	22.0	40.0	20.0
66	24.0	17.0	19.0	40.0	20.0
67	24.0	17.0	19.0	40.0	20.0
68	24.0	17.0	19.0	100.0	20.0
69	24.0	17.0	19.0	100.0	20.0
70	34.0	17.0	19.0	100.0	20.0
71	40.0	17.0	19.0	100.0	100.0
72	40.0	17.0	19.0	100.0	100.0
73	40.0	17.0	19.0	100.0	100.0
74	40.0	17.0	19.0	100.0	100.0
75	100.0	100.0	100.0	100.0	100.0

Additional increments for retirees who have fifteen or more years of service at retirement on or after age 60

8.0%	2.0%	2.0%	na	na
------	------	------	----	----

Additional increments for retirees in the year in which they are first eligible for unreduced retirement prior to age 60

12.5%	7.5%	7.5%	15.0%	na
-------	------	------	-------	----

TABLE VIII (Continued)

SUMMARY OF ACTUARIAL METHODS AND ASSUMPTIONS

Commencement Dates and Forms of Payment

Retiring participants are assumed to elect the normal form of payment commencing immediately.

Terminating participants and inactive participants who are entitled to future benefits are assumed to elect the normal form of payment commencing at the age at which a member is eligible for an unreduced service retirement benefit.

Expenses

The assumed Interest Rate disclosed above is net of investment expenses. A 0.22% load is included in the Actuarially Determined Contribution Rates for administrative expenses.

TABLE IX

EFFECT OF REVISED ACTUARIAL METHODS AND ASSUMPTIONS
ON KEY VALUATION RESULTS

There were no changes in actuarial methods and assumptions since the previous valuation that impacted results.

TABLE X-1
 INFORMATION ON POLITICAL SUBDIVISIONS
 VALUATION BALANCE SHEET
June 30, 2018

ASSETS	Legacy Plan	Alternative Plan	Hybrid Plan No Controls	Hybrid Plan With Controls	Total Polisubs
Present assets creditable to:					
State Accumulation Fund	\$8,639,016,604	\$121,036	\$1,657,664	\$1,281,448	\$8,642,076,752
Members' Fund	1,321,172,837	265,706	700,139	4,646,543	1,326,785,225
Total Present Assets	\$9,960,189,441	\$386,742	\$2,357,803	\$5,927,991	\$9,968,861,977
Present value of prospective contributions payable to:					
State Accumulation Fund:					
Normal	\$1,287,814,205	\$452,608	\$6,906,162	\$8,229,897	\$1,303,402,872
Accrued Liability	187,974,621	54,364	(234,736)	395,310	188,189,559
Total	\$1,475,788,826	\$506,972	\$6,671,426	\$8,625,207	\$1,491,592,431
Members' Fund	673,089,164	1,219,779	2,858,707	32,787,914	709,955,564
Total Prospective Contributions	\$2,148,877,990	\$1,726,751	\$9,530,133	\$41,413,121	\$2,201,547,995
Total Assets	\$12,109,067,431	\$2,113,493	\$11,887,936	\$47,341,112	\$12,170,409,972
LIABILITIES					
Present value of prospective benefits payable on accounts of:					
Present retired members and contingent annuitants	\$4,488,960,969	\$0	\$0	\$2,628	\$4,488,963,597
Present active members	6,347,251,968	2,103,593	11,655,930	46,684,949	6,407,696,440
Former members	1,272,854,494	9,900	232,006	653,535	1,273,749,935
Total Liabilities	\$12,109,067,431	\$2,113,493	\$11,887,936	\$47,341,112	\$12,170,409,972

TABLE X-2
 INFORMATION ON POLITICAL SUBDIVISIONS
 SCHEDULE OF FUNDING PROGRESS
June 30, 2018

Funding Group	Actuarial Value of Assets	Actuarial Accrued Liability	Unfunded Actuarial Accrued Liability	Funded Ratio	Covered Payroll	Unfunded Actuarial Accrued Liability as a Pct of Covered Payroll
Legacy Plan	\$9,960,189,441	\$10,148,164,062	\$187,974,621	98.15%	\$2,747,035,422	6.84%
Alternative Plan	386,742	441,106	54,364	87.68%	2,244,620	2.42%
Hybrid Plan - No Controls	2,357,803	2,123,067	(234,736)	111.06%	16,737,672	(1.40%)
Hybrid Plan - With Controls	5,927,991	6,323,301	395,310	93.75%	66,694,389	0.59%
Total Polisubs	\$9,968,861,977	\$10,157,051,536	\$188,189,559	98.15%	\$2,832,712,103	6.64%

TABLE XI

LETTER RELATED TO THE PUBLIC SAFETY OFFICER BRIDGE BENEFIT

February 14, 2019

Mr. Jamie Wayman
Director
Tennessee Consolidated Retirement System
502 Deaderick Street
Nashville, TN 37243-0201

Dear Jamie:

Re: Supplement to TCRS June 30, 2018 Actuarial Valuation (Legacy Pension Plans)

The purpose of this letter is to finalize the contribution rate associated with the public safety officer bridge benefit and to document the net contribution rate for the Consolidated State group from the June 30, 2018 TCRS actuarial valuation of the Closed State and Higher Education Employee Pension Plan.

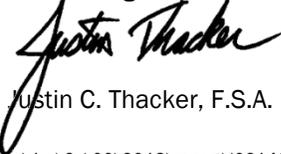
Communications associated with the June 30, 2018 actuarial valuation disclose the total Consolidated State contribution rate, including the cost associated with the public safety officer bridge payments. The total contribution rate can be separated into a public safety officer contribution rate and a general Consolidated State contribution rate to reflect contributions specifically collected to fund the public safety officer bridge benefit.

According to calculations determined in conjunction with the June 30, 2018 actuarial valuation, the public safety officer bridge benefit results in an extra contribution rate to be applied only to public safety officer payroll of 3.68%. The anticipated collection of this amount reduces the total Consolidated State contribution rate by 0.14% of payroll, resulting in a net contribution rate for the Consolidated State group of 19.66% (19.80% - 0.14%) according to the June 30, 2018 actuarial valuation.

As a result, a contribution rate of 23.34% (19.66% + 3.68%) should be charged to the public safety officer payroll, while 19.66% should be used as the general Consolidated State contribution rate in order to satisfy the total contribution rate recommendations of the June 30, 2018 actuarial valuation.

Please advise if we may provide additional information or be of assistance in any way.

Kindest regards,



Justin C. Thacker, F.S.A.

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TABLE XII
ACTUARIAL CERTIFICATION

Purpose and Use:

This report has been prepared exclusively for the Tennessee Consolidated Retirement System to determine the funding level of the plan based on the June 30, 2018 valuation, and may not be appropriate for other purposes. A separate report will provide the financial disclosure items required by the Governmental Accounting Standards Board. Findley is not responsible for consequences resulting from the use of any part of this report without prior authorization or approval. This report provides actuarial advice and does not constitute legal, accounting, tax or investment advice. Determinations for other purposes, such as bond ratings or judging benefit security, may be significantly different from the results shown in this report.

Actuarial findings in this report are based on actuarial assumptions which reflect expected plan experience. Although the deviation of the actual future plan experience and the expected experience inherently creates some uncertainty with the results, in our opinion the actuarial assumptions reasonably reflect the expected future experience of the plan. Future actuarial measurements may differ significantly from the current measurements presented in this report due to such factors as the following: plan experience differing from that anticipated by the economic or demographic assumptions; changes in economic or demographic assumptions; increases or decreases expected as part of the natural operation of the methodology used for these measurements (such as the end of an amortization period or additional cost or contribution requirements based on the plan's funded status); and changes in plan provisions or applicable law. Due to the limited scope of the assignment, we did not perform an analysis of the potential range of such future measurements.

Data:

The calculations shown in this report have been prepared using employee data and plan documentation furnished by the Tennessee Consolidated Retirement System as of June 30, 2018 and plan assets furnished by the Tennessee Consolidated Retirement System for the twelve month period ending June 30, 2018. While we have not audited the data, we have reviewed it for reasonableness and internal consistency, and to the best of our knowledge, there are no material limitations to the data provided.

Subsequent Events:

We are unaware of any subsequent event after the dates above which would have a material effect on the results presented in this report.

Assumptions, Methods and Procedures:

The actuarial calculations contained in the report are built on deterministic actuarial modeling, making a single determination of liabilities and costs. Further, these actuarial calculations are based on a combination of demographic and asset data, as well as assumptions concerning future changes in these data. As such, the actuarial calculations contained herein are an estimate of projected future occurrences.

Changes in Plan Provisions, Actuarial Assumptions and Methods:

The mortality improvement assumption adopted with the 2016 experience study utilizes the most current projection scale published by the Society of Actuaries as of the actuarial valuation date. As of June 30, 2018, the projection scale was updated from Scale MP-2016 to Scale MP-2017. This change resulted in a decrease in the liabilities and contribution rates.

The load included in the Actuarially Determined Contribution Rates for administrative expenses was increased from 0.19% to 0.22% effective June 30, 2018.

No other changes were made to the plan provisions, actuarial assumptions and methods effective June 30, 2018.

Summaries of the plan provisions, actuarial assumptions and methods can be found in Sections G and H of this report.

TCRS Funding Policy:

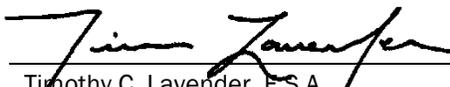
This report was prepared in accordance with the funding policy adopted by the TCRS Board of Trustees.

Professional Qualifications:

This report has been prepared under the supervision of Justin C. Thacker, a member of the American Academy of Actuaries, a Fellow of the Society of Actuaries, and a consulting actuary with Findley, who has met the Qualification Standards of the American Academy of Actuaries to render the actuarial opinions herein. To the best of our knowledge this report has been prepared in accordance with generally accepted actuarial standards, including the overall appropriateness of the analysis, assumptions, and results and conforms to appropriate Standards of Practice as promulgated from time to time by the Actuarial Standards Board, which standards form the basis for the actuarial report. We are not aware of any direct or material indirect financial interest or relationship, including investment management or other services that could create, or appear to create, a conflict of interest that would impair the objectivity of our work. The undersigned are available to provide supplemental information or explanation.


Justin C. Thacker, F.S.A.
Fellow, Society of Actuaries
Enrollment No. 17-6078
Phone 615.665.5387

October 7, 2019
Date


Timothy C. Lavender, F.S.A.
Fellow, Society of Actuaries
Enrollment No. 17-6745
Phone 615.665.5305

October 7, 2019
Date